NUCLEAR SCIENCE ABSTRACTS

Volume 31 Number 2

Abstracts 2743-5541

January 31, 1975

UNITED STATES ATOMIC ENERGY COMMISSION

REPORT COLLECTIONS IN THE UNITED STATES

The libraries listed below purchase and maintain microfiche collections of USAEC and foreign reports that are abstracted in *NSA*. Their collections also include *NSA* and its indexes, AEC's Technical Progress Reviews, AEC-sponsored translations, conference proceedings published by AEC, and various bibliographic tools. Most of these libraries have microfiche reader-printers or other photocopy facilities with which to reproduce enlarged copies from microfiche. Charges for reproduction services vary.

Report collections of USAEC reports in countries other than the United States are listed on the inside back cover.

- **ALABAMA**
  - Auburn, Auburn University
  - Tuskegee Institute, Tuskegee Institute
- **ALASKA**
  - College, University of Alaska
- **ARIZONA**
  - Tucson, University of Arizona
- **CALIFORNIA**
  - Davis, University of California
  - Los Angeles, University of California
  - Santa Barbara, University of California
- **COLORADO**
  - Boulder, University of Colorado
- **DISTRICT OF COLUMBIA**
  - Washington, Library of Congress
- **FLORIDA**
  - Gainesville, University of Florida
- **GEORGIA**
  - Atlanta, Georgia Institute of Technology
- **HAWAII**
  - Honolulu, University of Hawaii
- **IDAHO**
  - Pocatello, Idaho State University
- **ILLINOIS**
  - Urbana, University of Illinois
- **INDIANA**
  - Lafayette, Purdue University
- **IOWA**
  - Ames, Iowa State University
- **KANSAS**
  - Manhattan, Kansas State University
- **KENTUCKY**
  - Lexington, University of Kentucky
- **MARYLAND**
  - Baltimore, Johns Hopkins University
  - College Park, University of Maryland
- **MASSACHUSETTS**
  - Cambridge, Massachusetts Institute of Technology
  - Worcester, Worcester Polytechnic Institute
- **MICHIGAN**
  - Ann Arbor, University of Michigan
- **MISSISSIPPI**
  - State College, Mississippi State University
- **MISSOURI**
  - Columbia, University of Missouri
  - Kansas City, Linda Hall Library
- **NEW JERSEY**
  - Princeton, Princeton University
- **NEW MEXICO**
  - Albuquerque, University of New Mexico
- **NEW YORK**
  - Albany, New York State Library
  - Albany, State University at Albany
  - Ithaca, Cornell University
  - New York, Columbia University
  - Rochester, University of Rochester
  - Syracuse, Syracuse University
  - Troy, Rensselaer Polytechnic Institute
- **NORTH CAROLINA**
  - Raleigh, North Carolina State University
- **OHIO**
  - Cincinnati, University of Cincinnati
  - Cleveland, Cleveland Public Library
- **OHIO (Continued)**
  - Columbus, Ohio State University
  - Toledo, University of Toledo
- **OKLAHOMA**
  - Norman, University of Oklahoma
- **PENNSYLVANIA**
  - Philadelphia, University of Pennsylvania
  - Pittsburgh, Carnegie Library
  - University Park, Pennsylvania State University
- **PUERTO RICO**
  - San Juan, University of Puerto Rico
- **SOUTH CAROLINA**
  - Columbia, University of South Carolina
- **TENNESSEE**
  - Knoxville, University of Tennessee
- **TEXAS**
  - Austin, University of Texas
  - College Station, Texas A & M University
  - Houston, Rice University
- **UTAH**
  - Salt Lake City, University of Utah
- **VIRGINIA**
  - Blacksburg, Virginia Polytechnic Institute
  - Charlottesville, University of Virginia
- **WASHINGTON**
  - Pullman, Washington State University
  - Seattle, University of Washington
- **WEST VIRGINIA**
  - Morgantown, West Virginia University
- **WISCONSIN**
  - Madison, University of Wisconsin

USAEC reports so indicated in *Nuclear Science Abstracts* are offered for sale by National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161.

Volume 31, Number 2, January 31, 1975

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Office of Information Services
Published by the USAEC Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the USAEC Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts.*

Atomic Energy of Canada Limited
Australian Atomic Energy Commission
Danish Atomic Energy Commission
Finnish Atomic Energy Commission
French Atomic Energy Commission
Japan Atomic Energy Bureau–Atomic Energy Research Institute
Commissie Nucleaire Informatieverzorging (Netherlands)
Institutt for Atomenergi (Norway)
Aktiebolaget Atomenergi (Sweden)
United Kingdom Atomic Energy Authority
Zentralstelle für Atomkernenergie-Dokumentation (West Germany)

Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts.* The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts,* available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

HOW TO OBTAIN NUCLEAR SCIENCE ABSTRACTS

Nuclear Science Abstracts is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

NSA is issued in two volumes per calendar year, one beginning January 15, the other July 15. Each volume consists of twelve issues.

For the two 12-issue volumes, the annual subscription rate is $121.05 for domestic subscribers and $151.35 for foreign subscribers. A single issue costs $5.05 domestic rates or $6.26 foreign rates. Domestic rates apply to the United States, Canada, Mexico, and Central and South American countries except Argentina, Brazil, Guyana, French Guiana, Surinam, and British Honduras.

Indexes are cumulated for each volume, i.e., on a six-month volume basis. If purchased on an annual subscription basis the two volume indexes are priced at $44.40 for domestic subscribers and $55.50 for foreign subscribers.

The volume indexes are also sold separately. Each volume index is priced on the basis of pagination at the time of publication.

Previous *NSA* cumulative indexes are available:

From Johnson Reprint Corporation, 111 Fifth Avenue, New York, N. Y. 10003:
Vols. 1–4, Subjects and Authors (1948–1950), $30.00.

From Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830:
Vols. 5–10, Subjects and Authors (1951–1956), $5.25.

Vols. 11–15, Subjects (1957–1961), $19.00.
Vols. 11–15, Personal Authors (1957–1961), $14.25.
Vols. 11–15, Corporate Authors (1957–1961), $2.50.

From Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402:
Vols. 16–20, Subjects (1962–1966), $36.00.
Vols. 16–20, Personal Authors (1962–1966), $22.50.
Vols. 16–20, Corporate Authors (1962–1966), $3.75.

Vol. 26, Subjects and Authors (1972), $37.75.

Vol. 27, Subjects, Authors, and Report Numbers (Jan.–June 1973), $16.90.

Vol. 28, Subjects and Authors (July–Dec. 1973), $18.55.

Vol. 29, Subjects and Authors (Jan.–June 1974), $20.10.

Cumulative Report Number Index, Vols. 1–15 Revised, $4.00.

Cumulative Report Number Index, Vols. 16–20 Revised, $5.50.

Cumulative Report Number Index, Vols. 21–28, $9.35.

From Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106:
Vols. 21–25, Subjects, Authors, and Corporate Authors (1967–1971), $195.00.

Nuclear Science Abstracts is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Government agencies may obtain *NSA* free of charge. Inquiries should be directed to the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

Nuclear Science Abstracts is also available on 16-mm and 35-mm microfilm in reel or cartridge from Princeton Microfilm Corporation, Alexander Road, Princeton, New Jersey 08540. The cost of Vols. 1–26 (1948–1972) including *Abstracts of Declassified Documents* (1947–1948) is $730.00. The indexes for *Nuclear Science Abstracts* Vols. 1–26 (1948–1972) are also available for $385.00. The cost of each volume (six months) of *NSA* and its indexes is $45.

INDEXES TO NSA

Comprehensive indexes appear in each issue and are cumulated at the end of each volume. The report number indexes will be cumulated on both a volume and two-volume basis. Multivolume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

CARTER, G., See REED, D.J., 30:21824
CASA, A.F., Nuclear energy in Japan, 30:23243
CASARETT, A.P., See KALLFELZ, F.A., 30:21411
CASCI, C., Method for preliminary analysis of MHD generator performance, 30:20916 (AGARD-CP-104)

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

REACTOR CONTROL SYSTEMS/PERFORMANCE
  Optimization of control-rod programming in multiregion nuclear reactors, 30:23184
REACTOR COOLING SYSTEMS/TRANSIENTS
  WFLASH: a FORTRAN-IV computer program for simulation of transients in a multi-loop PWR, 30:23171 (WCAP-8261(Rev.1))
REACTOR CORES/INSPECTION
  Initial results of a holographic tomosynthesis technique for fuel-core inspection, 30:23198
REACTOR CORES/STRESS ANALYSIS
  Methods of stress analysis in use at General Atomic for core design (HTGR graphite moderator), 30:23078 (GA-A-12870)

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

23214 (HEDL-TME-74-16) ANALYSIS OF TEMPERATURE PROFILES IN TRANSIENTLY HEATED UO_2 USING MOLYBDENUM INCLUSIONS. Wilmot, E. L. **(Hanford Engineering Development Lab., Richland, Wash. (USA)).** [nd]. Contract AT(45-1)-2170. 23p. AT.

is indexed as:

HANFORD ENGINEERING DEVELOPMENT LAB., RICHLAND, WASH. (USA)
  Analysis of temperature profiles in transiently heated UO_2 using molybdenum inclusions, 30:23214 (HEDL-TME-74-16)
  HEDL quarterly technical report, January--March 1974. Volume I. Materials technology, 30:21815 (HEDL-TME-74-1(Vol.1))
  Modeling of the post-irradiation fuel-cladding gap in mixed-oxide fuels, 30:23103 (HEDL-TME-74-19)
  Preliminary data report: post-irradiation examination of fuel pins PNL-10-23 and PNL-10-63, 30:23149 (HEDL-TME-74-23)
  Prototype applications loop two years of operation, 30:20928 (HEDL-TME-74-24)

Report Numbers

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

SU-IPR-		
518	**30:22074**	**See N-74-15472**
SZS-	**(F.R. Germany)**	
154	**30:22967**	**Dep. NTIS (US Sales Only), $4.75**
156	**30:21178**	**Dep. NTIS (US Sales Only), $4.25**
158	**30:21359**	**Dep. NTIS (US Sales Only), $4.25**
159	**30:20815**	**Dep. NTIS (US Sales Only), $4.75**
160	**30:21360**	**Dep. NTIS (US Sales Only), $5.75**
TID-		
3910(Suppl.9)	**30:21128**	**Dep. NTIS, $5.45**
26580	**30:23377**	**Dep. NTIS, $9.25**
26595	**30:21670**	**Dep. NTIS, $4.00**

AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

TABLE OF CONTENTS

Volume 31, Number 2, January 31, 1975

Category *Page*

CHEMISTRY 285
- Analytical and Separations Chemistry 285
  - *Activation and Nuclear Reaction Procedures* 285
  - *Chemical and Spectral Procedures* 287
  - *Radiometric and Radiochemical Procedures* 291
  - *Separation Procedures* 293
- Inorganic, Organic, and Physical Chemistry 295
  - *Chemical and Physicochemical Properties* 295
  - *Isotope Effects* 296
  - *Isotope Exchange and Isotope Separation* 298
  - *Feed Materials Processing* 299
- Radiation Chemistry 300
- Radiochemistry and Nuclear Chemistry 308
  - *Hot-Atom Chemistry* 308
  - *Properties of Radioactive Materials* 309
  - *Radioactive Waste Treatment* 312
  - *Radioisotope Production* 313
  - *Reactor Fuel Reprocessing* 314

CONTROLLED THERMONUCLEAR RESEARCH 316
- Confinement and Heating 316
- Diagnostics 317
- Kinetics (General) 318
- Kinetics (Experimental) 319
- Kinetics (Theoretical) 319
- Production 321
- Stability 322
- Thermonuclear Engineering and Equipment 324
- Wave Phenomena 329

ENGINEERING 332
- Energy Conversion 332
- Facilities and Equipment 332
  - *Lasers* 334
  - *Cryogenic and Superconducting Equipment and Devices* 336
- Heat Transfer and Fluid Flow 337
- Materials Testing 338
- Nuclear Explosions 339
- Protective Structures and Equipment 341
- Safety Engineering 341

ENVIRONMENTAL AND EARTH SCIENCES 342
- Minerals and Ores 342
- Radioactive Effluents 342
- Radioactivity Monitoring and Transport 343
  - *Atmosphere* 348
  - *Soil* 350
  - *Water* 350
  - *Ecosystems and Food Cycles* 351
- Radiometric Techniques 352
- Site Surveys 353
- Thermal Effluents 354
- Chemical Effluents 358

Category *Page*

INSTRUMENTATION 359
- Radiation Detection Instruments 359
  - *General Detectors and Monitors* 359
  - *Radiation Dosimeters* 363
  - *Nuclear Spectroscopic Instrumentation* 365
  - *High Energy Physics Instrumentation* 367
- Radiometric Instruments 369
- Radiation Effects on Instrument Components, Instruments, or Electronic Systems 369
- Miscellaneous Instruments 370

ISOTOPE AND RADIATION SOURCE TECHNOLOGY 372
- Isotope Separation (Industrial) 372
- Isotopic Power Sources 372
- Radiation Sources 373
  - *Design and Fabrication* 373
  - *Industrial Uses* 373

LIFE SCIENCES 375
- Radiation Effects on Biochemicals 375
- Radiation Effects on Cells 376
- Radiation Effects on Microorganisms 377
- Radiation Effects on Plants 379
- Radiation Effects on Animals 381
  - *Man* 381
  - *Vertebrates* 385
  - *Invertebrates* 388
- Radionuclide Effects (Internal Source) 388
  - *Man* 388
  - *Animals* 389
- Nuclide Kinetics and Toxicology 390
  - *Man* 390
  - *Animals* 391
  - *Plants* 392
- New Tracer Techniques 392

MATERIALS 395
- Ceramics and Cermets 395
- Metals and Alloys 399
  - *Corrosion and Erosion* 399
  - *Preparation and Fabrication* 400
  - *Properties, Structure, and Phase Studies* 401
  - *Radiation Effects* 412
- Other Materials 413

NUCLEAR MATERIALS AND WASTE MANAGEMENT 416
- Accountability and Safeguards 416
- Disposal and Storage 417
- Handling Equipment and Procedures 419
- Transportation 420

TABLE OF CONTENTS (continued)

Category *Page*

- **PARTICLE ACCELERATORS** 422
  - Design, Development, and Operation 422
  - Auxiliaries and Components 422
  - Ion Sources and Injection and Extraction Systems 424
  - Ion Optics and Field Calculations 425
  - Storage Rings 425
  - Experimental Facilities 426

- **PHYSICS (ASTROPHYSICS AND COSMOLOGY)** 428
  - Cosmic Radiation 428
  - Stars 432
  - Quasi-Stellar, Radio, and X-Ray Sources 441
  - Solar Phenomena 443
  - Galaxies 446
  - Cosmology 451
  - Planetary Phenomena 452

- **PHYSICS (ATMOSPHERIC)** 455
  - Auroral and Ionospheric Phenomena 455
  - Magnetospheric Phenomena 458

- **PHYSICS (ATOMIC AND MOLECULAR)** 461
  - Beams and Their Reactions 461
  - Atomic and Molecular Properties 462
  - Positronium, Muonium, and Muonic and Mesic Atoms and Molecules 465
  - Collision Phenomena 466
  - Atomic Theory 473

- **PHYSICS (ELECTROFLUID AND MAGNETOFLUID)** 476

- **PHYSICS (HIGH-ENERGY)** 477
  - Particle Interactions and Properties (Experimental) 477
    - *Electromagnetic* 477
    - *Weak* 477
    - *Strong (Baryon-induced)* 478
    - *Strong (Meson-induced)* 480
  - Particle Interactions and Properties (Theoretical) 482
    - *General* 482
    - *Electromagnetic* 483
    - *Weak* 487
    - *Strong (General)* 488
    - *Strong (Baryon No. = 0)* 490
    - *Strong (Baryon No. = 1)* 491
    - *Strong (Baryon No. > 2)* 493
  - Particle Invariance Principles and Symmetries 494
    - *General* 494
    - *Applications (Electromagnetic and Weak)* 495
    - *Applications (Strong)* 495
  - Scattering Theory 495

- **PHYSICS (LOW-TEMPERATURE)** 498
  - Superfluidity 498
  - Superconductivity 499

- **PHYSICS (NUCLEAR)** 502
  - Neutron Interactions with Matter 502
  - Nuclear Properties and Reactions, $A < 5$ 502
  - Nuclear Properties and Reactions, $6 < A < 19$ 504
  - Nuclear Properties and Reactions, $20 < A < 38$ 506

Category *Page*

- **PHYSICS (NUCLEAR) (Cont'd.)**
  - Nuclear Properties and Reactions, $39 < A < 58$ 506
  - Nuclear Properties and Reactions, $59 < A < 89$ 507
  - Nuclear Properties and Reactions, $90 < A < 149$ 508
  - Nuclear Properties and Reactions, $150 < A < 189$ 510
  - Nuclear Properties and Reactions, $190 < A < 219$ 511
  - Nuclear Properties and Reactions, $A > 220$ 511
  - Nuclear Theory 517

- **PHYSICS (RADIATION AND SHIELDING)** 522
  - Radiation Physics 522
  - Radiation Protection Standards 524
  - Radiation Source Calibration and Standardization 524
  - Shielding Calculations and Experiments 525

- **PHYSICS (THEORETICAL)** 526
  - General 526
  - Quantum Field Theories 528
  - Gravitation and General Relativity 530

- **REACTOR TECHNOLOGY AND REGULATION** 534
  - Power Reactors, Non-Breeding, BWR-Type 534
  - Power Reactors, Non-Breeding, PWR-Type 535
  - Power Reactors, Non-Breeding, Graphite Moderated 537
  - Power Reactors, Non-Breeding, Otherwise Moderated 539
  - Power Reactors, Breeding 539
  - Research, Test, and Experimental Reactors 542
  - Production and Materials Testing and Processing Reactors 544
  - Propulsion and Package Reactors 544
  - Reactor Safety and Environmental Aspects 544
  - Reactor Theory and Calculation 549
  - Reactor Components and Accessories 550
  - Reactor Fuels 553
  - Reactor Control Systems 554
  - Nuclear Power Plant Economics 555
  - Reactor Fuel Cycle Economics 556
  - Reactor Licensing and Regulation 557

- **GENERAL AND MISCELLANEOUS** 559
  - Civilian Defense 559
  - Energy Utilization and Economics 559
  - Law 561
  - Management 561
  - Mathematics and Computers 562
  - Miscellaneous 566
    - *Chemistry* 567
    - *Life Sciences* 567
    - *Materials* 567
    - *Physics and Engineering* 570

- **CORPORATE INDEX** INDEX-1

- **PERSONAL AUTHOR INDEX** INDEX-17

- **SUBJECT INDEX** INDEX-64

- **REPORT NUMBER INDEX** INDEX-188

STAFF OF NUCLEAR SCIENCE ABSTRACTS

Editor and Production Manager
David E. Bost

Assistant Editor
Lee M. Thompson

Associate Editors
M. Catherine Grissom
Robert C. Kelly
Sidney F. Lanier
Henry D. Raleigh
Charles E. Stuber

Report Evaluators
John H. Mitchell
Mary H. Newman

Descriptive Cataloging Specialist
J. Paul Meredith

Subject Heading Specialist
Dora H. Moneyhun

Corporate Author Specialist
Clara L. Fox

Report Number Specialist
Helen W. White

Information Specialists
E. Ray Bedford
Jane G. Buchanan
D. Lamar Cason
David C. Cunningham
Theodore F. Davis
James R. Dulaney
Darrell O. Galde
Martha W. Gerrard
Everett J. Hoffman
Carolyn D. Houston
Lynda H. Kern
W. Hugh Kinser
Lisbeth C. Lieberman
William D. Matheny
Jean F. Peckham
Mona H. Raridon
Julia S. Redford
Stanley J. Rimshaw
Jesse W. Rushing
Robert W. Rutkowski
Francis S. Sachs
Lila B. Smith
Polly C. Summers
Helen L. Ward
Lawrence T. Whitehead
Milton O. Whitson
Martha C. Wilson

Publishing Coordinator
Charles R. Bruce

Computer Processing Coordinator
Noboru Kawakami

Communication concerning the editorial policy and content of *Nuclear Science Abstracts* should be addressed to the Editor, *Nuclear Science Abstracts*, USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

Use of funds for printing this publication approved by the Director of the Office of Management and Budget, June 19, 1972.

Volume 31, Number 2 January 31, 1975

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

2743 (AERE-Bib-187) LIST OF UNCLASSIFIED DOCUMENTS, LECTURES, ETC. BY THE STAFF OF CHEMISTRY DIVISION, AERE, HARWELL, 1973. Asbury, J. (comp.). (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jul 1974. 14p. Dep. NTIS (US Sales Only) $4.00. UK 50 pence.

This list constitutes unclassified material published or presented during 1973 by the staff of Chemistry Division and covers reports, memoranda, conference papers, books and articles in journals. (auth)

2744 167TH NATIONAL MEETING OF THE AMERICAN CHEMICAL SOCIETY, LOS ANGELES, CALIFORNIA, MARCH 31–APRIL 5, 1974. Abstracts of Papers. Washington, DC; American Chemical Society, Special Issues Sales (1974). vp. (CONF-740349-(Absts.)). $9.00.

Analytical and Separations Chemistry

Refer also to abstract 4008.

2745 (NBL-272, pp 42–43) MONTE CARLO METHOD FOR RELATING STRUCTURE AND URANIUM CONTENT OF PYROCARBON- AND SILICON CARBIDE-COATED FUEL BEADS. Hedrick, C. E. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2746 (UCID-1564-74-2) GENERAL CHEMISTRY DIVISION QUARTERLY REPORT, APRIL–JUNE 1974. Harrar, J. E. (comp. and ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1974. Contract W-7405-eng-48. 52p. Dep. NTIS $5.75.

Research progress is reported on: simulation modeling of a mixed oxide fuel rod fabrication plant, pilot laboratory automation, analytical support of the LLL geothermal project, development of a microwave spectrometer, determination of uranium and tritium, solution dispensing system, optical pumping of neodymium laser glass, laser isotope separation, vaporization of UCl_3, cesium vapor source, studies of URe_2, electron microprobe analysis, explosive composites, analysis of gas from detonations, ion selective electrodes, outgassing of high explosives, and analysis of explosives. (MCG)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 3522, 4357–4359, 4935, and 4939.

2747 (GSF-B-385) NORMAL CONCENTRATIONS OF VARIOUS ELEMENTS IN ORGANS AND BODY FLUIDS. A Compilation of Data Published by Various Authors. Kollmer, W. E.; Iyengar, G. V. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Abt. fuer Nuklearbiologie). Dec 1972. 109p. (In German).

Concentrations of 14 essential (Ca, Co, Cr, Cu, Fe, K, Mn, Mo, Na, Ni, P, Se, Sn, Zn), 4 toxic (As, Cd, Hg, Pb), and further 4 (Al, Br, Rb, W) elements in 25 different organs and body fluids of man and animals are summarized. These results partly differ from one another and were obtained by neutron activation analysis and other techniques. (GE)

2748 (NBL-272, pp 97–104) DETERMINATION OF URANIUM-235 BY DELAYED NEUTRON COUNTING USING INTERMEDIATE ENERGY NEUTRON INTERROGATION. Hagenauer, R. C.; Zyskowski, C. L.; Nelson, L. C. Jr. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2749 (RT/CHI-(74)8) DETERMINATION OF THE TOTAL CONTENT OF Ag, As, Au, Co, Cr, Re, Sb, U, AND Zn IN NATURAL WATERS BY NEUTRON ACTIVATION ANALYSIS. Battiston, U.; Moauro, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jun 1974. 31p. (In Italian). Dep. NTIS (US Sales Only) $4.75.

Ag, As, Au, Co, Cr, Hg, Re, Sb, U, Zn were determined in natural water samples by thermal neutron activation; the cooling time was reduced to 1 to 2 days by using an ionic exchange separation after irradiation. By this method the above elements in samples from the Tiber River were determined and also the distribution ratio between liquid and solids in suspension was examined. (auth)

2750 ANALYSIS OF URANIUM BY DELAYED FISSION NEUTRON COUNTING METHOD. Reddy, G. R.; Sankar Das, M. (Bhabha Atomic Research Centre, Trombay, India). Indian J. Chem.; 12: No. 4, 405–409(Apr 1974).

Details of a rapid procedure for the measurement of uranium by the delayed neutron counting method are described. These include fabrication of the equipment, evaluation of sensitivity, precision, accuracy and range of application. The reliability of the method has been evaluated by analyzing a number of international standard samples and is shown to be satisfactory. The sensitivity of the method is 0.1 μg for uranium and it is 100 μg for thorium. Data on the uranium content of various crustal rocks, sediments, soils, archaeological samples, high purity materials and biological samples are also given. (auth)

2751 NEUTRON ACTIVATION ANALYSIS OF Mn, Cu, AND Gd IN FERRITES USING A LINEAR ELECTRON ACCELERATOR. Vaivads, Ya. K.; Mednis, I. V.; Pelekis, L. L.; Riekstinya, D. V. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 4, 3-7(1974). (In Russian).

Methods were developed for neutron activation analysis of Mn and Cu in spinels and Gd in garnets. A device was used in the linear electron accelerator as a neutron source producing the thermal neutron flux density of 10^8 n/cm$^2\cdot$sec. The Mn and Cu determination was performed simultaneously by the induced activities of ^{56}Mn and ^{64}Cu. The internal standard method was employed for the Gd determination. The measurements were made with a Ge(Li) γ-spectrometer. The threshold of detectability was found to be $2\cdot10^{-5}$ g Mn, $1.7\cdot10^{-4}$ g Cu, and $2.4\cdot10^{-4}$ g Gd. (auth)

2752 DETERMINATION OF A HAFNIUM IMPURITY IN ZIRCONIUM AND ITS ALLOYS BY A NEUTRON ACTIVATION METHOD. Ovechkin, V. V.; Rudenko, V. S. Sov. At. Energy (Engl. Transl.); 35: No. 4, 943–945(Oct 1973).

Translated from At. Energ. (USSR); 35: No. 4, 277-278(Oct 1973).

The possibilities of quantitative determination of hafnium in zirconium and its alloys, based on the use of a low-voltage generator of 14-MeV neutrons, which are additionally moderated in a paraffin block, as the source of activation are discussed. Use of an isotopic ^{238}Pu–Be source was also studied. Both the low-voltage generator and the isotopic ^{238}Pu–Be source can be used for the highly sensitive and rapid analysis of zirconium and its alloys for hafnium content. (LK)

2753 ANALYTICAL CHEMISTRY IN INDUSTRIAL TOXICOLOGY. Klisenko, M. A. Zh. Vses. Khim. Obshchest. im. D. I. Mendeleeva; 19: No. 2, 169-178(1974). (In Russian).

A review with 202 references on instrumental methods of determination of microquantities of toxic materials and their metabolic products in air, biological material, and other media. Chromatographic, spectrometric, electrochemical, kinetic, and neutron-activation analytical methods are reviewed. Data on the sensitivity and selectivity of various methods are reported. (JPRS)

2754 ACTIVATION ANALYSIS FOR ENVIRONMENTAL PROTECTION. Schramel, P.; Samsahl, K. (Physikalisch-Technische Abteilung, Neuherberg, Ger.). pp 296-299 of Umweltschutz bei nuklearer und konventioneller energiegewinnung. Braun, H. (ed.). Stuttgart; Geog Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

A brief explanation is given of the methods of neutron activation analysis and its physical principles. The uses of this analysis technique for environmental monitoring are outlined. (JSR)

2755 RARE EARTH DETERMINATIONS IN ORES BY NEUTRON ACTIVATION USING SEMICONDUCTOR DETECTORS FOR X AND SOFT GAMMA RAYS. Vaganov, P. A.; Ponomarev, V. S.; Eakhtiarov, A. V.; Meier, V. A.; Zhukovskii, A. N.; Plotnikov, R. I. Uch. Zap. Leningrad. Gos. Univ., Ser. Fiz. Geol. Nauk; No. 23, 223-228(1973). (In Russian).

Germanium radiation detectors were successfully used in neutron-activation analysis of ores for Ta, Eu, Ce, Hf, and Tl at concentrations of the order of 10^{-5}%. Under optimum activation and measurement conditions the analytical sensitivity can be increased and additional elements can be determined. (tr-auth)

2756 HALOGEN IMPURITIES IN CdS AND ZnSe CRYSTALS BY THERMAL NEUTRON ACTIVATION. Kim, C. K.; Voris, S. S. (Bell Telephone Labs., Murray Hill, NJ). J. Phys. Chem. Solids; 35: No. 10, 1381-1384(Oct 1974).

Halogen donors (chlorine, bromine and iodine) in cadmium sulfide and zinc selenide single crystals (vapor grown platelets with and without halogen dopants) were determined by thermal neutron activation analysis. This approach proved to be simple, rapid, and highly selective. The analyzed impurity contents range from 100 ppB to several ppM. Radionuclides used for identification of chlorine, bromide and iodine were ^{38}Cl ($t_{½} \simeq$ 25 min), ^{82}Br ($t_{½} \simeq$ 35.1 hr) and ^{128}I ($t_{½} \simeq$ 25 min), respectively; these nuclides were radiochemically isolated and measured by gamma scintillation spectrometry. The levels of the impurities measured by this method were then used to identify new types of donor-acceptor pair line spectra and two-electron transitions associated with chlorine, bromine or iodine impurities. The results were all in good agreement with the suspected lines, and accordingly well characterized. (auth)

2757 EFFECT OF BODY THICKNESS ON IN VIVO NEUTRON ACTIVATION ANALYSIS. McNeill, K. G.; Kostalas, H. A.; Harrison, J. E. (Univ. of Toronto). Int. J. Appl. Radiat. Isotop.; 25: No. 8, 347-353(Aug 1974).

In the procedure of in vivo neutron activation analysis for calcium and other elements, the thickness of the body affects both neutron flux distribution in the body and self-absorption of γ rays emitted by the body. Measurements were carried out to find the effects of these factors individually and also when combined. With the Pu-Be neutron source and NaI detector arrangements used at Toronto for activation analysis of the trunk, the combined changes in calcium counts are about 5% for each 1 cm change in the thickness of the subject. (auth)

2758 SUBSTOICHIOMETRIC EXTRACTION WITH HEXAFLUOROACETYLACETONE AND TRI-N-OCTYLPHOSPHINE OXIDE IN CYCLOHEXANE. Determination of manganese by neutron activation. Mitchell, J. W.; Ganges, R. (Bell Telephone Labs., Murray Hill, NJ). Talanta; 21: No. 7, 735-743(Jul 1974).

Traces of manganese were determined quantitatively by neutron activation and substoichiometric extraction with a mixture of hexafluoroacetylacetone and tri-n-octylphosphine oxide in cyclohexane. When applied to calcium carbonate, the specific example cited here, it was necessary to make a prior separation of manganese by extraction with a mixture of pyrrolidinedithiocarbamic acid and diethylammonium dithiocarbamate in chloroform to avoid interferences from calcium. Replicate determination of sub-ppM amounts of manganese in a sample of calcium carbonate showed a relative standard deviation of 6.9% while measurements on a solution prepared by dissolving a refined-silicon standard, SRM 57, indicated a relative error of 6.0%. (auth)

2759 SEPARATION OF GOLD FROM LEAD-RICH MINERALS FOR NEUTRON-ACTIVATION ANALYSIS. Das, N.; Bhattacharyya, S. N. (Saha Inst. of Nuclear Physics, Calcutta). Talanta; 21: No. 8, 894-896(Oct 1974).

An easy method for the recovery of gold from lead-rich minerals was developed. The gold is extracted with methyl isobutyl ketone from an aqua regia solution of the mineral, then stripped into aqueous medium by evaporating the solvent, and finally co-precipitated with lead sulphide. The gold is uniformly distributed in the lead sulphide. (auth)

2760 MAGNESIUM DISTRIBUTIONS IN ALUMINUM USING A DEUTERON MICROBEAM. Olivier, C. (Atomic Energy Research Establishment, Harwell, Eng.); Peisach, M. Radiochem. Radioanal. Lett.; 19: No. 3, 227-236(25 Oct 1974).

Magnesium concentration profiles were determined in aluminium-rich alloys with a 21-μm-wide microbeam of 1800-keV deuterons, using prompt proton spectrometry. The sensitivity limit was found to be 0.37% magnesium (by mass). (auth)

2761 INFLUENCE OF SUMMATION IN THE DETERMINATION OF RELATIVE COUNTING EFFICIENCIES. de Bruin, M.; Korthoven, P. J. M. (Interuniversity Reactor Inst., Delft, Netherlands). Radiochem. Radioanal. Lett.; 19: No. 3, 153-156(25 Oct 1974).

A good knowledge of the relative efficiency curve of a Ge(Li)-detector is often important in instrumental activation analysis. In the determination of an efficiency curve, errors may occur due to summation effects in the detector. This paper gives an indication of the extent of these errors and the way in which a correction can be calculated. (auth)

2762 ALUMINUM-BASED DILUTE ALLOYS OBTAINED IN A PLASMA FURNACE AND CONTROLLED BY ACTIVATION ANALYSIS. Samadi, A. A. (Centre d'Etudes de Chimie Metallurgique, Vitry, France); Grynszpan, R.; Fedoroff, M. Radiochem. Radioanal. Lett.; 19: No. 3, 171-177(25 Oct 1974).

Homogeneous aluminum-based alloys containing Cu, Mn, Pd, Pt, Ir, Ru or Os in the 0.5 to 20,000 μg/g range have been obtained by melting in a plasma furnace. Concentrations were determined by neutron activation analysis. This method achieved the accuracy range of 1%, as it was shown by comparison with the expected values and with those obtained by double irradiation technique and atomic absorption spectrometry. (auth)

2763 MEASURING MERCURY IN PHEASANT LIVERS BY NEUTRON ACTIVATION ANALYSIS. Ervin, P. F.; Eckhoff, N. D. (Kansas State Univ., Manhattan). Trans. Kans. Acad. Sci.; 76: No. 1, 1–3(Spr 1973).

Portions of fourteen pheasant livers from pheasants harvested in Jewell County, Kansas, were analyzed for mercury by neutron activation analysis. Mercury concentrations ranged from nodetectable quantities to 32 parts per billion (10^{-9} gm/gm). Detected mercury concentration values agree well with detection limits previously determined. (auth)

2764 DETERMINATION OF PARTICULATE AIR POLLUTANTS IN MEXICO CITY USING ACTIVATION ANALYSIS. Navarrete, M. (UNAM, Mexico City); Galvez, L.; Tzontlimatzin, E.; Aguilar, C. Radiochem. Radioanal. Lett.; 19: No. 3, 163-170 (25 Oct 1974).

Activation analysis has been used to determine the air pollution by particulate matter in Mexico City, attempting to find its main sources and mechanisms since this is one of the most serious cases of atmospheric contamination by dust. In this paper the results are presented for twelve samples, taken over a 3-day period during the autumn season in four stations located at the north, south, east and center of the huge city. (auth)

2765 DETERMINATION OF TRACE CADMIUM IN BIOLOGICAL MATERIALS BY NEUTRON AND PHOTON ACTIVATION ANALYSES. Jervis, R. E.; Tiefenbach, B.; Chattopadhyay, A. (Univ. of Toronto). Can. J. Chem.; 52: No. 17, 3008-3020(1 Sep 1974).

Two nuclear activation techniques have been applied for the determination of trace cadmium residues in a variety of Canadian foodstuffs, soils, and other biological materials. A neutron activation procedure based on radiochemical isolation of ^{115}Cd has been used for p.p.b. concentrations in foods, vegetables, and scalp hair whereas an instrumental photon activation method employing assay of ^{111m}Cd with a solid state Ge(Li) detector has been useful for soil, fertilizer, and a few vegetation samples at p.p.m. levels. For the latter technique, bombardment at either 15 or 35 MeV has been used, the higher energy bombardment gave a slightly higher sensitivity. However, in samples containing appreciable amounts of indium and tin, interference is minimized by irradiating at the lower energy. The cadmium content of most Canadian foods ranged from 2–70 p.p.b; agricultural soils studied contained 0.5–2 p.p.m., some of which could be attributed to fertilizers containing up to 5 p.p.m. of cadmium, whereas vegetable crops grown on such soils generally contained 0.1–0.2 p.p.m. For scalp hair, cadmium concentrations ranged from 0.25–2.7 p.p.m. The accuracy of the nuclear activation techniques was assessed with standard reference materials and by comparison with atom absorption and the agreement was generally in the range of 2–7%. (auth)

2766 ^{227}Ac–Be ISOTOPIC NEUTRON SOURCE FOR APPLICATION IN HIGH-ACCURACY NEUTRON ACTIVATION ANALYSIS. Alaerts, L.; op de Beeck, J. P.; Hoste, J. (State Univ., Ghent, Belg.). Anal. Chim. Acta; 69: No. 1, 1-9(Mar 1974).

An annular ^{227}Ac–Be isotopic neutron source, containing 6.6 Ci ^{227}Ac, is described for application in fast and thermal neutron activation analysis, with high accuracy, for major constituents in ores, alloys, and industrial concentrates. The characteristics of the neutron output and of the fast, epithermal and thermal flux and flux gradients is described in detail. The determination of manganese in pyrolusite ores and ferro-manganese is compared to results obtained previously with a cylindrical 1-Ci ^{226}Ra–Be source. Two new sources of systematic errors were discovered. (NL)

2767 γ-ACTIVATION ANALYSIS OF CARBON IN THORIUM AND URANIUM. Gorenko, A. F.; Skakun, N. A.; Shevchenko, G. M.; Zadvornyi, A. S.; Bugaeva, N. I.; Klyucharev, A. P. Sov. At. Energy (Engl. Transl.); 34: No. 1, 71-73(Jan 1973).

Translated from At. Energ. (USSR); 34: No. 1, 53-54(Jan 1973).

Bremsstrahlung γ photons used in the activation were generated on a tungsten converter by a beam of 30-MeV electrons. The cross section of the reaction $^{12}C(\gamma,n)^{11}C$ is quite large, and the 20.74 min half-life is convenient for analytical purposes. After the sample was irradiated, it was transferred to a facility for carbon determinations by the method of oxidative fusion. Under the activation conditions selected (electron energy 30 MeV, current 10 μA, exposure time 20 min), the sensitivity of the carbon determination in U and Th was 1.3×10^{-7} g. The method can be used for the analysis of C in other heavy elements as well. (JGB)

Chemical and Spectral Procedures

Refer also to abstracts 3290, 3318, 3589, 3590, 5220, and 5235.

2768 (CEA-N-1698) QUANTITATIVE X-RAY MICROANALYSIS USING AN ENERGY DISPERSIVE ANALYZER ON A SCANNING ELECTRON MICROSCOPE. Servant, J. M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Mar 1974. 104p. (In French). Dep. NTIS (US Sales Only) $8.25.

Quantitative measurements using an Energy Dispersive X Ray Analyzer (E.D.X.) on a Scanning Electron Microscope (S.E.M.) equipped with a regulated beam and an anticontamination device were performed. The obtained spectra are treated by a commercial minicomputer on line with the detector (system NS 880). The experimental intensities are corrected through a Z.A.F. method with the COR program on a IBM 360. Sixty six measurements were done on different alloys, some of them presenting overlapping peaks (Ti–Al, Fe–Al, Zr–Ni, Nb–Al, Ti–Zr, Mg–Al, Fe–Mn, Ti–V–Cr). The errors, the advantages and the limits of the method are discussed. The minimum detectable limits were calculated. With E.D.X. on a S.E.M., the rapid and simultaneous quantitative microanalysis of all the elements of 11 < = Z < = 92 of the target can be performed, with the precision obtained by wave length dispersion spectrometry. (FR)

2769 (CNAEM-R-124) RAPID AND ROUTINE DETERMINATION OF THE PRINCIPAL ELEMENTS CONTAINED IN URANIUM MINERAL LEACH SOLUTIONS. Uzmen, R.; Gueltepe, E. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). 1973. 17p. (In French). Dep. NTIS (US Sales Only) $4.00.

In the industrial treatment of uranium ores it is essential to know the composition of the leached solution before proceeding with recovery of the uranium. This is why one needs methods of analysis which are relatively quick, simple, and inexpensive. With this aim a method was developed to make rapid and routine determinations of the amount of aluminum, iron, and uranium present in solution with excess of sulphate and phosphate ions. The method contains essentially two new ideas: a paper chromatographic method sensitive enough to separate and determine the uranium content in the presence of complex anions such as the sulphates and the phosphates; an investigation into the effect of the phosphate complexes on molar yields of aluminum and iron obtained from the determination of the amounts of these elements present. The analytical procedure developed has been applied successfully to an artificial leached solution showing that it may be used for leached solution from any type of uranium ore. (auth)

2770 (EURFNR-1166) APPARATUS FOR SODIUM DISTILLATION FOR ANALYTICAL PURPOSES "NADESTAN 4". Borgstedt, H. U.; Peric, Z.; Wittig, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Feb 1974. Translation of KFK–1941. 20p. Dep. NTIS (US Sales Only) $4.00.

Work performed under United States-Euratom Fast Reactor Exchange Program.

Operation of an apparatus for analytical application of sodium distillation was begun. The apparatus "NADESTAN 4" is part of a process chain comprehending the sodium sampling by-pass of the sodium loop, the pure atmosphere sodium handling box, and the distillation device itself. The sodium overflow samples collected in nickel crucibles are distilled in a glass vessel separated from the sodium loop. The sodium is evaporated by induction heating. By the process the sodium metal can be separated from the contaminants, which can be analyzed in the residue of the distillation with high sensitivity. The new apparatus is in use for analyses of sodium samples out of the high-temperature corrosion loop, the wear test rig, and the tank facility for self welding experiments. The results of oxygen analyses are in good agreement to cold trap temperatures of the loops and to the output of emf oxygen meters operated in the same loops. (auth)

2771 (FRNC-TH-495) ANALYSIS OF ELEMENT TRACES BY CHARACTERISTIC X-RAY SPECTROSCOPY. Lecoq, P. (Grenoble-1 Univ., 38 (France)). 1973. 96p. (In French). Dep. NTIS (US Sales Only) $8.00.

Thesis.

The fundamental theory of excitation of the characteristic x rays of an element by γ rays or charged-particle bombardment (theory developed by Merzbacher and Lewis in the framework of the Born approximation; Garcia model based on the impulse approximation) is given. The experimental set-up used is described: the computer programs employed are presented in grouped form. The system used is highly adaptable and equally suited to either on-line processing, or to studies at a later date. Two series of experiments on the analysis of mineral water and iron-chrome alloys are presented. (FR)

2772 (KFK-2009) SPECTROCHEMICAL INVESTIGATION OF CORROSION- OR DIFFUSION ZONES OF CORRODED CLADDING MATERIALS USING A GLOW DISCHARGE LAMP. Schneider, H.; Schumann, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Jul 1974. 36p. (In German). Dep. NTIS (US Sales Only) $5.00.

A spectrochemical method is described for the analysis of corrosion or diffusion zones. The excitation and the removal are effected by a glow discharge lamp (Fa. RSV) over a spherical area of 8-mm diameter. Using this method cladding tube samples of stainless steel Nr. 1.4970, 1.4988 and 1.4981 were analyzed after corrosion in sodium. Preliminary investigations were made by a quartz-spectrograph 110 M (Fa. Fuess) and the concentration levels of Cr, Ni and Mn in the surface layers were determined. Further investigations were carried out using a vacuum spectrometer with stationary slits for about 10 elements (Fe, Cr, Ni, Mn, Co, Nb, Ti, Mo, V, B, and C) and automatic measurement of the intensities. Precise working instructions are described and discussed. The concentration profiles of the elements in the diffusion zones of corrosion samples after exposure in sodium at 700°C are plotted. (auth)

2773 (LA-5672) SEALED-TUBE DISSOLUTION METHOD FOR DETERMINATION OF NITRIDE NITROGEN IN BORON CARBIDE. Perrin, R. E.; Zerwekh, A.; Ashley, W. H. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1974. Contract W-7405-eng-36. 6p. Dep. NTIS $4.00.

Nitride nitrogen in B_4C is determined by dissolving the sample in 14M H_2SO_4 in a sealed fused-silica tube, distilling the nitrogen as ammonia from alkaline solution, and titrating the ammonium hydroxide in the distillation receiver with standardized acid. The Winkler distillation and the titration are proven operations that are directly applicable to the analysis of the B_4C solution. Recovery of nitrogen from B_4C was difficult and time-consuming by the usual caustic-fusion and leach methods, but it was simplified by substituting the technique of high-temperature dissolution in 14M H_2SO_4. With the sealed-tube method, analysis of six prepared mixtures of BN and B_4C gave a mean recovery of 99.9% nitrogen, with a standard deviation of 0.94%. Fourteen portions of B_4C production material gave a mean nitrogen value of 917 ppM, with a standard deviation of ± 30 ppM. Twelve analyses of the same material by the caustic-fusion method gave a mean nitrogen content of 928 ppM, with a standard deviation of ± 84 ppM. The sealed-tube method for determining nitrogen is highly selective; none of the impurities found in B_4C interfere. (auth)

2774 (NBL-272) ANNUAL PROGRESS REPORT FOR THE PERIOD JULY 1973 THROUGH JUNE 1974. Bingham, C. D. (USAEC New Brunswick Lab., N. J.). Oct 1974. 121p. Dep. NTIS $5.45.

Citations are included for the 28 summaries contained in the report. (ERB)

For title listing of individual papers see: 2745, 2748, 2775–2798, 2830, and 2856.

2775 (NBL-272, pp 5-8) EFFECT OF IMPURITIES ON THE NEW BRUNSWICK LABORATORY TITRIMETRIC METHOD OF DETERMINING URANIUM. V. Silver, Gold, Lead, Iodine, Arsenic, Antimony, and Bismuth. Bodnar, L. Z.; Lerner, M. W.; Scarborough, J. M. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2776 (NBL-272, pp 9-11) EFFECT OF HIGH ACID CONCENTRATION ON THE DETERMINATION OF URANIUM AT THE 10-MILLIGRAM LEVEL BY THE NEW BRUNSWICK LABORATORY TITRIMETRIC METHOD. Bodnar, L. Z. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2777 (NBL-272, pp 12) APPLICATION OF THE NEW BRUNSWICK LABORATORY METHOD OF DETERMINING URANIUM IN ORGANIC EXTRACTS. Bodnar, L. Z.; Lerner, M. W.; Scarborough, J. M. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2778 (NBL-272, pp 13-25) RUGGEDNESS TESTING OF THE NEW BRUNSWICK LABORATORY TITRIMETRIC METHOD OF DETERMINING URANIUM. Bodnar, L. Z.; Lerner, M. W. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2779 (NBL-272, pp 26-28) EFFECT OF TEMPERATURE AND TEMPERATURE CONTROL ON THE ACCURACY OF THE NEW BRUNSWICK LABORATORY TITRIMETRIC METHOD OF DETERMINING URANIUM. Bodnar, L. Z.; Lerner, M. W. Oct. 1974.

In annual progress report for the period July 1973 through June 1974.

2780 (NBL-272, pp 29-31) DETERMINATION OF URANIUM UTILIZING CONTROLLED-POTENTIAL COULOMETRIC OXIDATION FOLLOWING REDUCTION BY FERROUS ION IN PHOSPHORIC ACID. Lewis, K.; Lerner, M. W. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2781 (NBL-272, pp 32-35) AMPEROMETRIC DETERMINATION OF URANIUM AFTER REDUCTION WITH IRON(II) IN PHOSPHORIC ACID. Lewis, K. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2782 (NBL-272, pp 36-37) AUTOMATED URANIUM TITRATORS. Goldbeck, C. G. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2783 (NBL-272, pp 38-41) INTERNAL QUALITY ASSURANCE PROGRAM FOR URANIUM ASSAY. Pietri, C. E.; Jacob, E.; Bracey, J. T. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2784 (NBL-272, pp 44) DETERMINATION OF URANIUM IN PYROCARBON- AND SILICON CARBIDE-COATED FUEL BEADS. Hedrick, C. E.; Scarborough, J. M. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2785 (NBL-272, pp 45-46) PREPARATION OF SAMPLES FOR PHASE II OF THE INTERLABORATORY COMPARISON PROGRAM ON THE ANALYSIS OF HIGH TEMPERATURE GAS-COOLED REACTOR FUEL. Trahey, N. M.; Bingham, C. D. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2786 (NBL-272, pp 47-48) NEW BRUNSWICK LABORATORY DIRECT READING SPECTROMETER. Yuster, H. G. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2787 (NBL-272, pp 49-50) FABRY-PEROT INTERFERENCE SPECTROMETER. Yuster, H. G. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2788 (NBL-272, pp 51-53) SPECTROCHEMICAL DETERMINATION OF TUNGSTEN IN IRIDIUM. Yuster, H. G. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2789 (NBL-272, pp 54-57) DETERMINATION OF REFRACTORY ALUMINUM OXIDE IN URANYL NITRATE HEXAHYDRATE BY ATOMIC ABSORPTION SPECTROPHOTOMETRY. Graff, R. L. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2790 (NBL-272, pp 58-60) NEW BRUNSWICK LABORATORY'S ANALYZED SAMPLES FOR SPECTROGRAPHIC ANALYSIS. Goldbeck, C. G.; Pinto, L. J. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2791 (NBL-272, pp 61) SPARK SOURCE MASS SPECTROMETRIC DETERMINATION OF VOLATILE IMPURITIES IN URANIUM HEXAFLUORIDE. Callis, E. L. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2792 (NBL-272, pp 62-65) DETERMINATION OF TUNGSTEN IN IRIDIUM BY ISOTOPE DILUTION SPARK SOURCE MASS SPECTROMETRY. Callis, E. L. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2793 (NBL-272, pp 66-73) IMPROVED FOCAL PROGRAM FOR AN ISOTOPE RATIO MASS SPECTROMETER. Callis, E. L.; Connolly, V. E. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2794 (NBL-272, pp 78-80) AUTOMATED COULOMETRY SYSTEM (AUTOCOULOMETRY) FOR PLUTONIUM. Weiss, J. R.; Wenzel, A. W.; Pietri, C. E. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2795 (NBL-272, pp 82-88) COMPARISON OF CALORIMETRIC AND CHEMICAL ASSAY METHODS FOR THE DETERMINATION OF PLUTONIUM. Pietri, C. E. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2796 (NBL-272, pp 89) DISPOSABLE "HATS" IN MASS SPECTROMETRIC ISOTOPIC ANALYSIS. Summers, A. W.; Connolly, V. E. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2797 (NBL-272, pp 90-96) NEW BRUNSWICK LABORATORY OS/8 MINI-COMPUTER OPERATING SYSTEM. Nelson, L. C. Jr. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2798 (NBL-272, pp 105-111) NONDESTRUCTIVE DETERMINATION OF URANIUM-235 USING A DIFFERENTIAL ABSORPTION-GAMMA RAY METHOD. Hagenauer, R. C.; Zyskowski, C. L.; Nelson, L. C. Jr. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2799 (NBS-MISC.PUBL.-260-6) STANDARD REFERENCE MATERIALS: METHODS FOR THE CHEMICAL ANALYSIS OF WHITE CAST IRON STANDARDS. Final Report. Shultz, J. I. (National Bureau of Standards, Washington, D. C. (USA)). 16 Jul 1965. 68p. (COM-74-11068). NTIS $6.50.

The procedures described in this publication are those used at the National Bureau of Standards in the analysis of white cast iron standard reference materials for the ten (10) major elements; namely, carbon, manganese, phosphorus, sulfur, silicon, copper, nickel, chromium, vanadium, and molybdenum. Carbon and sulfur are determined by combustion; manganese, chromium and vanadium by titrimetry; phosphorus, copper and molybdenum by photometry; and silicon and nickel by gravimetry. (GRA)

2800 (NBS-MISC.PUBL.-260-8) STANDARD REFERENCE MATERIALS: ANALYSIS OF URANIUM CONCENTRATES AT THE NATIONAL BUREAU OF STANDARDS. Final Report. Richmond, M. S. (National Bureau of Standards, Washington, D. C. (USA)). 1 Dec 1965. 106p. (COM-74-11066). NTIS $8.50.

Experiences with the problems of assaying uranium concentrates are described. Umpire determinations of uranium were performed on several thousands of ore concentrates from worldwide sources. Contributions were made to the resolution of the sampling base line problem. Also, it was demonstrated that the standard U_3O_8, NBS No. 950A, provides the over-all standard necessary for precise assay of uranium materials. A comprehensive analytical procedure applicable to all types of uranium concentrates is presented. (GRA)

2801 (UCID-16627) STANDARDIZATION OF A SPECTROGRAPHIC METHOD FOR THE DETERMINATION OF CONSTITUENTS IN LOW-ALLOY STEELS. Garza, R. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Aug 1974. Contract W-7405-eng-48. 19p. Dep. NTIS $4.00.

A general method for analyzing low-alloy steels in a concentration range of 0.05% to 1.00% was developed. The method was standardized for the determination of Mo, Mn, Ni, and Cr using iron as an internal standard. One of the principal advantages in using a solution method is that many problems of sample form and metallurgical history are eliminated. (auth)

2802 (UCRL-51652) SPECTROPHOTOMETRIC DETERMINATION OF NEODYMIUM IN LASER GLASSES. Haugen, G. R.; Rigdon, L. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Sep 1974. Contract W-7405-Eng-48. 10p. Dep. NTIS $4.00.

A procedure was developed to determine the neodymium in laser glasses. The method is based on the ionic absorption of Nd (III) in perchloric acid at 795.5 nm. Samples containing 0.3 to 6 wt % neodymium may be analyzed with a relative accuracy and precision of 1.12%. The method is applicable to a variety of glass formulations. Among the few interferences are Dy (III), Er (III), and Tm (III), which are not commonly present in laser glasses. The use of internal standards and reiterative regression analysis to obtain the extinction coefficient of Nd (III) in solutions of glasses improves the accuracy and precision of the method. Statistical analysis of the results of 22 glass samples representing several glass formulations are presented. (auth)

2803 AMPEROMETRIC DETERMINATION OF Ce(IV) WITH α-NAPHTHYLAMINE. Vartanyan, S. V.; Tarayan, V. M. (Erevan State Univ.). Arm. Khim. Zh.; 27: No. 6, 469-473(1974). (In Russian).

Ce(IV) can be determined by the amperometric method with α-naphthylamine. The titration was carried out in 0.3–8.3N H_2SO_4 and 1–3N HCl medium. It has been shown that Ce(IV) and α-naphthylamine react in 4 : 1 mol. ratio. (auth)

2804 SENSITIVITY OF SPECTROGRAPHIC ANALYSIS OF DRY RESIDUES OF SOLUTIONS. Silakova, V. G.; Makulov, N. A.; Manova, T. G.; Bozhevol'nov, E. A. (All-Union Scientific-Research Inst. of Chemical Reagents and Special Purity Chemicals, Moscow). Zh. Anal. Khim.; 29: No. 9, 1683-1689(Sep 1974). (In Russian).

The sensitivity of spectrographic analysis of solution dry residues dried on carbon discs has been increased by using multifactor experiment design. The optimal composition of a carrier three-component mixture has been determined by means of a simple-latticed plan. A standard chemical-spectrographic method has been developed for analysis of special purity liquids, mineral acids, and various organic solvents. The method allows determination of 24 impurities with limits of detection of between $n \cdot 10^{-7}$ and $n \cdot 10^{-11}$ g. (auth)

2805 CATALYTIC DETERMINATION OF RUTHENIUM WITH AMPEROMETRIC MEASUREMENT OF THE REACTION RATE. Alekseeva, N. N.; Rysev, A. P.; Sinitsyn, N. M.; Zhitenko, L. P.; Yakshinskii, A. I. (Moscow Inst. of Fine Chemical Tech.). Zh. Anal. Khim.; 29: No. 9, 1859-1862(Sep 1974). (In Russian).

A procedure is suggested of determining ruthenium in various substances which is based on its catalytic effect in the reaction of oxidation of ferroin with potassium periodate using amperometric measurement of the reaction rate. The procedure makes it possible to increase the reaction sensitivity (to $5 \cdot 10^{-6}$ μg Ru/ml) and selectivity. (auth)

2806 TRIHYDROXYFLUORONE DERIVATIVES AS SPECTROPHOTOMETRIC REAGENTS FOR DETERMINATION OF TELLURIUM. Nazarenko, V. A.; Shitareva, G. G.; Poluektova, E. N.; Yakovleva, T. P. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 29: No. 9, 1850-1853(Sep 1974). (In Russian).

Seven derivatives of 2,3,7-trihydroxy-6-fluorone have been examined as reagents for tellurium(IV). Four of them can be used for photometric determination of tellurium. The rest of them 5,5-methylene-bis-salicylfluorone form with tellurium a complex with the molar absorptivity $3.5 \cdot 10^4$. Selenium does not react with the reagents studied. (auth)

2807 ORGANIC REAGENTS IN ANALYTICAL CHEMISTRY OF SELENIUM AND TELLURIUM. V. Spectrophotometric Study of Reactions of Tellurium(IV) with Rhodamine 6G and Butyl Rhodamine B. Skripchuk, V. G.; Murashova, V. I. (Ural Polytechnic Inst., Sverdlovsk, USSR). Zh. Anal. Khim.; 29: No. 9, 1823-1830(Sep 1974). (In Russian).

Ion associates formed by bromide anionic complexes of tellurium(IV) with rhodamine 6G cations are well flotated by low-polar solvents. The flotation maximum is located at 4.8 M H_2SO_4, 0.2 H KBr, and $4.4 \cdot 10^{-4}$ M rhodamine 6G in the aqueous phase. The flotation significantly increases the selectivity of determining tellurium by using rhodamine 6G. The apparent molar absorptivity for ethanol as extractant is $1.7 \cdot 10^5$. A linear correlation between the optical density of ethanol solutions of the compound isolated by flotation and the tellurium(IV) concentration is observed within the range 0.1–2.5 μg Te/5 ml. The ion associates of tellurium(IV) with rhodamine dyes are formed stepwise. The 1 : 1 compounds are formed at a small reagent excess (close to an equimolar one) and the 1 : 2 compounds at a large reagent excess. The method of determining tellurium by means of rhodamine 6G has been tested on various commercial materials and products. (auth)

2808 USE OF A COPPER ELECTRODE IN GALVANOSTATIC COULOMETRY. Kostromin, A. I.; Badakshanov, R. M. (Kazan State Univ.). Zh. Anal. Khim.; 29: No. 9, 1782-1787(Sep 1974). (In Russian).

Conditions have been examined for quantitative generation of copper (I) at a constant current intensity in chloride and phosphoric-chloride solutions from anodic polarization curves and by analysis of copper ionization products. The electrogenerated cuprous ions have been used to determine microgram amounts of $Cr_2O_7^{2-}$, Ce(IV), MnO_4^-, VO_3^-, Au(III), Fe(III), Pt(IV), V(IV) and MoO_4^{2-}. The possibility has been shown of simultaneous determination of the oxidizing agents enumerated in binary mixtures. Copper (I) generated from the copper anode has been used to determine Mn and Fe in brass and Mn, Cr, and V in steel. (auth)

2809 METHANYL YELLOW AS ADSORPTION INDICATOR. Chernova, M. A.; Frumina, N. S.; Mushtakova, S. P. (Saratov State Univ., USSR). Zh. Anal. Khim.; 29: No. 9, 1775-1781(Sep 1974). (In Russian).

Optimal conditions have been found for argentometric determination of halides using methanyl yellow as adsorption indicator. The mechanism of indicator behavior of methanyl yellow has been ascertained from protonation and adsorption studies. (auth)

2810 DITHIOPYRYLMETHANE AND ITS ANALOGS AS ANALYTICAL REAGENTS. Study of Complex Formation Between Dithiodiantipyrylmethane and Gold, Bismuth, and Molybdenum. Dolgorev, A. V.; Lysak, Ya. G. (State Scientific-Research Inst. of Mine Chemical Raw Materials, Ramenskoe, USSR). Zh. Anal. Khim.; 29: No. 9, 1766-1770(Sep 1974). (In Russian).

Colored reactions have been studied between gold, bismuth, and molybdenum and dithiodiantipyrylmethane. A procedure has been worked out for determining gold with dithiodiantipyrylmethane in natural objects. (auth)

2811 LUMINESCENCE DETERMINATION OF HOLMIUM AND ERBIUM AS IMPURITIES IN PURE CERIUM DIOXIDE. Smirdova,

N. I.; Efryushina, N. P.; Poluektov, N. S. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 29: No. 9, 1719-1723(Sep 1974). (In Russian).

A procedure was developed of determining holmium and erbium as impurities in cerium dioxide from their luminescence in a CeO_2 based crystallophosphor. The sensitivity is $1 \cdot 10^{-4}$% Ho and $4 \cdot 10^{-6}$% Er in CeO_2. The relative standard deviation is 0.8 to 13%. (auth)

2812 EXTRACTION-SPECTROPHOTOMETRIC DETERMINATION OF DYSPROSIUM IN ITS MIXTURE WITH LANTHANUM. Poluektov, N. S.; Ovchar, L. A.; Lauer, R. S.; Potapova, S. F. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 29: No. 9, 1715-1718(Sep 1974). (In Russian).

It has been found that rare earths form with gallein and N-benzoylphenylhydroxylamine (BPHA) different-ligand complexes extracted into butanol and other solvents. The ratio of the components in the complexes is RE : Gall : BPHA = 1 : 1 : 2. A spectrophotometric procedure is suggested of determining dysprosium in a mixture with lanthanum based on extraction of the complexes with butanol followed by washing the extract with 0.4% solution of nitrilotriacetic acid. The lanthanum complex is decomposed completely, the dysprosium one partially. The sensitivity is 1% Dy_2O_3 in the mixture with La_2O_3. (auth)

2813 CRYSTALLIZATION ANALYTICAL CONCENTRATION OF MICROCOMPONENTS. VII. Spectrophotometric Determination of Copper and Iron in Cesium Iodide after their Crystallization Concentration. Blank, A. B.; Chepurnaya, V. G.; Eksperiandova, L. P.; Vakulenko, V. Ya. (All-Union Scientific-Research Inst. of Single Crystals, Scintillation Materials, and Special Purity Chemicals, Kharkov). Zh. Anal. Khim.; 29: No. 9, 1705-1709(Sep 1974). (In Russian).

Conditions have been examined of spectrophotometric determination of copper (down to $2 \cdot 10^{-6}$%) and iron (down to $1 \cdot 10^{-6}$%) from a single cesium iodide sample after their concentration by directed crystallization of the salt of a cryotectic composition. A setup is described for effective crystallization concentration of impurities in water-soluble salts. (auth)

2814 MASS SPECTROMETRIC DETERMINATION OF TRITIUM IN NEUTRON-IRRADIATED LITHIUM FLUORIDE. Kaushik, S. B.; Gupta, S. R.; Chatterjee, S. N.; Laroia, K. K. (Solid State Physics Lab., New Delhi). Indian J. Pure Appl. Phys.; 12: No. 5, 389-391(May 1974).

Semiquantitative estimates of the amount of tritium present in a neutron-irradiated lithium fluoride sample were made using a solid source mass spectrographic method. The spectra were recorded with electrodes made from the powder sample mixed with a known proportion of graphite. The values obtained by simple visual method compared favorably with the results of scintillation counting technique. (auth)

2815 POLAROGRAPHIC DETERMINATION OF Te(IV) WITH DIETHYLENETRIAMINE. Rao, A. L. J.; Kumar, A. (Punjabi Univ., Patiala, India). Indian J. Chem.; 12: No. 5, 542 (May 1974).

A new polarographic method for the determination of Te(IV) using diethylenetriamine in the presence of potassium chloride as supporting electrolyte has been developed. A single well-defined diffusion-controlled wave is obtained with $E_{1/2}$ = 1.025 V. Elements usually associated with Te(IV) do not interfere in this method. (auth)

2816 SIMULTANEOUS PLUTONIUM AND URANIUM ISOTOPIC ANALYSIS FROM A SINGLE RESIN BEAD: A SIMPLIFIED CHEMICAL TECHNIQUE FOR ASSAYING SPENT REACTOR FUELS. Walker, R. L.; Eby, R. E.; Pritchard, C. A.; Carter, J. A. (Oak Ridge National Lab., TN). Anal. Lett.; 7: No. 8-9, 563-574(1974).

The method uses basic anion resin to adsorb plutonium and uranium from 7 to 8 M HNO_3 solutions containing dissolved spent reactor fuels. After equilibrating the resin with the solution, a single bead is used to determine the isotopic composition of plutonium and uranium on sample sizes as small as 10^{-9} to 10^{-10} g of each element per bead. Isotopic measurements are essentially free of isobaric interferences and fission product contamination in the mass spectrometer is eliminated. A very small aliquot of dissolver solution containing 10^{-6} g of U and 10^{-8} g of Pu is sufficient sample for chemically preparing several resin beads. A single prepared bead is loaded onto a rhenium filament and analyzed in a two-stage mass spectrometer using pulse counting for ion detection to obtain the high sensitivity required. Total quantity of the elements, in addition to isotopic abundances, can be determined by isotope dilution. Other areas where the method may be useful are: in plutonium production, isotope separations, and for trace detection of contamination on reactor parts. (auth)

2817 CHEMICAL ANALYSES OF CANADIAN REFERENCE SAMPLES: SY-2 AND SY-3. Tetley, N. W.; Turek, A. (Univ. of Windsor, Ont.). Anal. Lett.; 7: No. 8-9, 621-626(1974).

Chemical analyses of the major and some of the minor constituents are reported for two new Canadian silicate rock standards recently introduced by the Department of Energy, Mines and Resources. To date quantitative chemical analyses have not yet been reported for these samples. The compositions of these rocks offer a useful range of values that are not currently covered by existing silicate rock standards. (auth)

2818 MICROANALYSIS OF ALL SIX PLATINUM METALS PRESENT IN A DROP BY RING-COLORIMETRY IN CONJUNCTION WITH SOLVENT EXTRACTION. Kaushik, N. K.; Mehra, H. C. (Univ. of Delhi). Talanta; 21: No. 7, 790-792(Jul 1974).

The ring-oven method, combined with solvent extraction, was used for the separation of all six platinum metals when present in μg-amounts in a drop of solution. The separated constituents are determined by ring-colorimetry. (auth)

2819 DETERMINATION OF MICROGRAM QUANTITIES OF GADOLINIUM BY CATHODE-RAY POLAROGRAPHY. Thakur, M. L. (Hammersmith Hospital, London). Talanta; 21: No. 7, 771-775(Jul 1974).

A cathode-ray polarographic method was developed for the determination of microgram quantities of gadolinium with the use of an azo-dye, Solochrome Violet RS. Disadvantages in the use of 0.1M potassium chloride, commonly recommended as electrolyte for the polarographic determination of rare earths, were demonstrated. The influence of pH, temperature, ligand concentration and purity, and the stability of the complex, were investigated for the optimum performance of the method. The linear range is 0.5 to 12 μg/ml of gadolinium. Interferences by some lanthanides and other cations were examined. (auth)

2820 DETERMINATION OF IODINE BY ATOMIC-ABSORPTION SPECTROMETRY USING THE PLATINUM-LOOP TECHNIQUE. Manfield, J. M. (Imperial Coll. of Science and Tech., London); West, T. S.; Dagnall, R. M. Talanta; 21: No. 7, 787-789 (Jul 1974).

The use of a platinum-loop atomizer and an electrodeless discharge lamp was applied to the atomic-absorption determination of iodine at the 183.0-nm resonance line. Oxygen was flushed from the light-path with argon, giving adequate radiation transmission characteristics and a sensitivity of 9 ppM of iodine for 1% absorption. The method is prone to both cationic and anionic interferences, but the use of cation-exchange and solvent-extraction procedures overcomes some of the problems. (auth)

2821 DETERMINATION OF NITROGEN-15 IN PLANT MATERIAL WITH AN EMISSION SPECTROMETER. Loyd-Jones, C. P.; Hudd, G. A.; Hill-Cottingham, D. G. (Univ. of Bristol, Eng.). Analyst; 99: No. 1182, 580-587(Sep 1974).

Instrumental and procedural modifications for the use of the Statron, Model NOI-5, emission spectrometer in the determination of nitrogen-15 are reported. An interpolative method is recommended for estimating the background of the nitrogen-14—nitrogen-15 peak. This method gives a linear relationship between the apparent percentage of nitrogen-15 and the actual percentage of nitrogen-15 over the lower, most commonly used range. Assays repeated at intervals over 2 months had standard errors of 0.75 per cent. The preparation of nitrogen gas samples for the emission spectrometer has been treated as a separate operation from the determination of total plant nitrogen. After a standard Kjeldahl digestion of the plant material, the ammonium ion is precipitated with a Nessler reagent. The supernatant is rejected and the precipitate treated with dilute hydrochloric acid to give an ammonium chloride solution, from which an aliquot is taken for a Dumas combustion in a discharge tube. Two operators can prepare and measure up to fifty samples per day. The method has been used to analyse a range of plant tissues from an apple nutrition experiment, during which replicate digestions and analyses gave values for nitrogen-15 enrichment that differed by an average of only 2.5 per cent. (auth)

2822 ANALYSIS OF TITANIUM-VANADIUM ALLOYS. Pribil, R.; Vesely, V. Hutn. Listy; 28: No. 9, 661-663(Sep 1973). (In Czech).

The determination of V in the presence of appreciable quantities of Ti was carried out by reducing V with ascorbic acid in the presence of ethylenediaminetetra-acetic acid (EDTA), or 1,2-diaminocyclohexane-N,N,N′,N′-tetra-acetic acid (DCTA), and by masking Ti with NH_4F. The alloy (0.5 g) was dissolved in conc. HNO_3. The insoluble fraction was dissolved in H_2SO_4 (1:3). Titanium was determined by an indirect method after retitration of DCTA by Zn^{2+} salt, V being masked by H_2O_2. Vanadium was determined by retitration of EDTA by Zn^{2+} salt, Ti being masked by NH_4F. Xylene orange was used, in both cases, as the indicator. (Metal. Abstr.)

2823 SPECTROPHOTOMETRIC DETERMINATION OF MICROQUANTITIES OF URANIUM IN OXIDES OF THE RARE-EARTH ELEMENTS. Kirillov, A. I.; Golentovskaya, I. P.; Vlasov, N. A. (Irkutsk State Univ., USSR). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 4, 437–439(Apr 1974).

Translated from Zavod. Lab.; 40: No. 4, 353–355(Apr 1974).

The complexing of uranium (UI) with glycine thymole blue in the presence of celyltrimethylammonium bromide was studied, and a method for the determination of microgram quantities of uranium in oxides of the rare-earth elements with prior isolation of the uranium by extraction with tri-n-octylamine was developed. (LK)

2824 CHEMICOSPECTRAL DETERMINATION OF IMPURITIES IN HIGH-PURITY TANTALUM COMPOUNDS. Goryanskaya, G. P.; Kaplan, B. Ya.; Merisov, Yu. I.; Nazarova, M. G. (State Scientific-Research and Design Inst. of the Rare Metal Industry, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 4, 440–442 (Apr 1974).

Translated from Zavod. Lab.; 40: No. 4, 356–358(Apr 1974).

Results of investigations of the development of a chemicospectral method for the determination of impurities (Al, Ba, U, Bi, W, Co, Fe, Ca, Mg, Mn, Cu, Mo, Ni, Nb, Sn, Pb, Ti, Cr, and Zr) in tantalum hydride, chloride, pentoxide, and lithium tantalate are presented. (LF)

2825 POLAROGRAPHIC ANALYSIS OF MIXTURES OF OXIDES IN MELTS. Sevryukov, N. N.; Skurupafis, K. A.; Kintana, M. T. (Univ. for the Friendship of Peoples, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 4, 460–462(Apr 1974).

Translated from Zavod. Lab., 40: No. 4, 373–375(Apr 1974).

The possibility of applying polarographic analysis to a mixture of oxides in a potassium nitrate–sodium nitrate melt, after heating the sample with ammonium nitrate, was investigated. Calibration curves are given for Zr^{2+}, Pb^{2+}, Cu^{2+}, Cd^{2+}, La^{3+}, Pr^{3+}, Gd^{3+}, and Dy^{3+}. The sensitivity of the method depends on the completeness of the removal of moisture from the melt in the cell. Under the authors' conditions, after electrolysis for 3h, the minimum quantity of lanthanides detectable with certainty was 1.5×10^{-3} g-ion per kg of melt (~0.0006g in the cell). (LK)

2826 USE OF THE ATOMIC-ABSORPTION METHOD IN THE ANALYSIS OF STEELS AND ALLOYS. (A Review of the Papers Published Between 1966 and 1971). Kharlamov, I. P.; Eremina, G. V. Ind. Lab. (USSR) (Engl. Transl.); 40: No. 4, 480–487(Apr 1974).

Translated from Zavod. Lab., 40: No. 4, 385–391(Apr 1974).

The use of atomic absorption spectroscopy for the analysis of steels and alloys is reviewed. Conditions for determination of the following individual elements and characteristics of the method are given in a table: Li, Cu, Ag, Au, Mg, Ca, Al, Sc, Ti, Nb, Ta, Cr, Mo, Se, Te, Mn, Fe, Co, Ni, Pd, Zn, Cd, Pb, Bi, Sb, As, W, V, Sn, Tl, and the rare earths. (76 ref.). (LK)

2827 SELECTION OF SPECTROSCOPIC BUFFERS BY THE HILL-CLIMBING METHOD. Berenshtein, L. E.; Gal'perina, E. M.; Segal, I. D. (Lenin State Univ., Tashkent). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 4, 497–499(Apr 1974).

Translated from Zavod. Lab., 40: No. 4, 400–402(Apr 1974).

The precision of spectral analysis depends on the bulk composition of the samples since changes in this composition cause a shift in the calibration curves. The effect of bulk composition can be reduced by the use of a spectroscopic buffer. Application of the hill-climbing method to the selection of the buffer mixture is described. Buffer compositions for the determination of beryllium and tin are given. (LK)

Radiometric and Radiochemical Procedures

Refer also to abstracts 3359, 3384, 3485, 3487, 3491, 3576, 3802, and 5251.

2828 (AD-782006) TRACE ANALYSIS OF HEAVY ELEMENTS BY X-RAY ENERGY SPECTROSCOPY. Deyoung, L. G. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Mar 1974. 76p. (GNE/PH-74-2). NTIS $7.00.

Thesis.

Trace analysis of heavy elements (Th and U) in the microgram to nanogram range is explored by x-ray energy spectroscopy. A focusing cathode electron gun, in conjunction with a newly constructed scattering chamber, is used to produce characteristic K x rays from thin metal foils. Characteristic K x rays are then used to produce characteristic L x rays of Th and U. De-excitation energies are measured by an intrinsic germanium detector. Using Pd foil, a beam current of 300 micro A and electron energies of 28 keV, detection of Th was achieved at 6.35×10^{-8} G. The above method will be applied to quantitative (trace) analysis of heavy elements in environmental media. Sensitivity of this x-ray energy spectroscopy system is compared to a previous system. (auth)

2829 (AERE-R-6331(Amend.)) DETERMINATION OF GADOLINIUM BY ION EXCHANGE AND NEUTRON ABSORPTION. Boswell, C. R.; Pierce, T. B.; Barclay, A. N. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jul 1974. 10p. Dep. NTIS (US Sales Only) $4.00. UK 50 pence.

A technique was developed for the analysis of gadolinium in aqueous solutions. This consists of absorption of the gadolinium on to a cation exchange resin and subsequent measurement of the attenuation of a beam of thermal neutrons by the resin. A system suitable for on-line analysis of gadolinium in solution, based on the above technique, is described and could operate at the 0.1 ppM concentration level. One possible application is for monitoring gadolinium as a moderator poison in water reactors. (auth)

2830 (NBL-272, pp 81) DETERMINATION OF PLUTONIUM ISOTOPIC COMPOSITION BY MASS SPECTROMETRY AND ALPHA SPECTROMETRY, AND AMERICIUM-241 CONTENT BY RADIO-COUNTING. Pietri, C. E. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2831 (NP-20227) FLUORIMETRIC DETERMINATION OF LOW CONCENTRATIONS OF RARE EARTHS IN YTTRIUM OXIDE AS MATRIX BY MEANS OF X-RAY IRRADIATION. Tiemann, E. (Technische Univ. Hannover (F.R. Germany). Fakultaet fuer Mathematik und Naturwissenschaften). 26 Nov 1973. 158p. (In German). INIS.

41 figs.; 31 tabs.; 96 refs. With abstract. Available from the library of Technische Univ. Hannover.

A method of analysis was developed to determine the quantity of samarium, terbium, europium, and erbium in yttrium oxide by means of x-ray produced fluorescence. The various parameters affecting the method, such as content of rare earths in the matrix, physical state of the matrix, chemical preparation conditions, influence of foreign ions, are discussed. The dependence of the fluorescence yields on such parameters can be kept within limits by the use of inner standards. By keeping to the given standard conditions, the contents of less than 1 ppm may be sufficiently accurately determined (relative standard deviation at approximately 100 ppM: about 4%). (GE)

2832 (PB-233497) RAPID IDENTIFICATION OF COPPER-BASE ALLOYS BY ENERGY DISPERSION X-RAY ANALYSIS. Report of Investigations. Marr, H. E. III. (Bureau of Mines, Washington, D. C. (USA)). May 1974. 20p. (BM-RI-7878). NTIS $3.00.

Energy dispersion x-ray analysis was evaluated for possible application in the secondary metals industries for the rapid analysis and identification of copper-base alloys. Laboratory investigations of standard brass and bronze samples indicate that x-ray methods are capable of separating standard alloys into ten general classes with analytical times of less than three seconds per sample for clean, flat samples. A radioactive source of ^{241}Am with a secondary fluorescer was used as an excitation source and a lithium-drifted silicon semiconductor detector was used for energy discrimination of x-rays. (GRA)

2833 (RT/FI-(74)32) NONDESTRUCTIVE MEASUREMENT OF THE Pu CONTENT IN PuO_2-UO_2 PELLETS BY GAMMA SPECTROMETRY. Giannini, M.; Oliva, P. R.; Ramorino, M. C.; Tomarelli, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jul 1974. 38p. (In Italian). Dep. NTIS (US Sales Only) $5.00.

Aim of this work is to investigate the potentiality of γ-ray spectrometry applied to the nondestructive measurement of plutonium in PuO_2-UO_2 sintered pellets. Two experimental arrangements have been set up, one using a Ge(Li) detector and the other using a NaI(Tl) scintillator. Both have advantages and disadvantages that are discussed in the present work. (auth)

2834 (SAND-74-0206) APPLICATIONS OF TUNABLE DYE LASERS IN REACTOR WASTE MANAGEMENT. Gobeli, G. W.;

Hargis, P. J. Jr.; Hohimer, J. P. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 23p. Dep. NTIS $4.25.

Verification of the very low permissible concentrations for radioactive isotopes in the effluent from nuclear fuel reprocessing plants is considered from the aspect of applications of narrow-band tunable dye lasers to the problem. The maximum permissible concentration of ^{137}Cs in the effluent was established as 2.5×10^{-13} g/ml, well below the detectable limit of currently available analytical techniques. Conventional atomic absorption spectroscopy can detect Cs down to levels of 5×10^{-8} g/ml. By simply replacing the hollow cathode lamp by a narrow-band dye laser tuned to the 852.11 nm line of Cs this value can be reduced to about 7×10^{-11} g/ml. By utilizing photon counting techniques together with absorption/fluorescence properties dependent on intracavity properties unique to the laser itself, it is estimated that this value can be further reduced to about 5×10^{-15} g/ml, well below the maximum permissible concentration level. (auth)

2835 (SGAE-2313) LEAST SQUARES AND CHANNEL CHOICE METHOD FOR THE DETERMINATION OF β-ACTIVE MULTILABELLED SAMPLES BY LIQUID SCINTILLATION. Krejsa, P.; Wagner-Loeffler, M.; Sorantin, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Strahlenschutz; Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Chemie). Aug 1974. 18p. (CH-143/74; ST-31/74). Dep. NTIS (US Sales Only) $4.00.

By optimization of channel settings and a least square fit method it was possible to extend the detection limits to a theoretically determinable range and to measure the activities of ^{3}H, ^{45}Ca, ^{90}Sr, ^{106}Ru, and ^{137}Cs in multilabelled samples simultaneously with a liquid scintillation counter. (auth)

2836 (UCRL-75204) COMPARISON OF THE IN SITU MEASUREMENT OF TERRESTRIAL AMERICIUM WITH A Ge(Li) SPECTROMETER AND A FIDLER. Roth, S. J.; Huckabay, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Nov 1973. 15p. (CONF-731101-57). Dep. NTIS $4.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The evaluation of the sensitivity of a Ge(Li) coaxial detector in comparison with a thin NaI(Tl) detector in in-situ terrestrial ^{241}Am is described. The experiment was performed in areas of natural background and fallout products. Of primary concern is the detection of ^{241}Am 60-keV gamma ray. Calculated from these data are the corresponding quantitations of ^{239,240}Pu. (auth)

2837 X-RAY FLUORESCENCE ANALYSIS OF MINERAL SAMPLES USING SOLID STATE DETECTOR AND RADIOISOTOPE X-RAY SOURCE. Gravitis, V. L.; Greig, R. A.; Watt, J. S. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Australas. Inst. Mining Met. Proc.; No. 249, 1-4 (Mar 1974).

The use of solid state detector and radioisotope x-ray source for x-ray fluorescence analysis is illustrated by analysis for iron, copper, zinc, tin, and lead in about 700 samples taken from Australian mineral process streams. Limits of detection based on counting statistics (3 standard deviations) range from 0.001 to 0.004% by weight element. The analysis accuracy was usually between 2 to 10% (rms) of the mean element concentration and was determined by comparison with assays supplied by mineral companies. In most cases the main cause of error appears to be due to this assay and not the x-ray fluorescence technique. Some potential fields of application of solid state detector and radioisotope x-ray source for analyses in the mineral industry are indicated. (auth)

2838 RADIOMETRIC DETERMINATION OF URANIUM USING A MODIFIED EICHHOLZ EQUATION. Holden, G. R. (Australian Mineral Development Labs., Frewville). AMDEL (Aust. Miner. Develop. Lab.) Bull.; No. 16, 45-55(Oct 1973).

A radiometric method, based on $\beta-\gamma$ counting is established for the determination of uranium. Modified equations are presented, together with experimental work. The radiochemical equilibrium of uranium and its daughter products is also studied. (AT)

2839 YADERNOFIZICHESKIE METODY OBOGASHCHENIYA POLEZNYKH ISKOPAEMYKH. (Nuclear-Physical Methods of Mineral Beneficiation). Tatarnikov, A. P. Moscow; Atomizdat (1974). 144p.

The physical bases of new methods of treating raw materials are explained briefly. A classification of raw materials is proposed. Particular attention is devoted to theoretical problems and the technology of various methods; the main factors determining the efficiency of ore identification are analyzed. Consideration is given to details of equipment for ore beneficiation and to the theoretical scheme of handling mineral ores by nuclear-physical methods. A number of new analytical methods (gamma-absorption, gamma-neutron, neutron activation and others) are described in detail. Problems of radiation safety are briefly discussed. (SJR)

2840 COMPARISON OF EQUAL-VELOCITY ION BEAMS FOR ELEMENTAL ANALYSIS BY ION-EXCITED X-RAY EMISSION. Cahill, T. A.; Flocchini, R. G.; Feeney, P. J.; Shadoan, D. J. (California Univ., Davis (USA). Crocker Nuclear Lab.). Nucl. Instrum. Methods; 120: No. 1, 193-195(15 Aug 1974).

This short study was made in order to examine the relative efficiency of proton and alpha beams in the performance of elemental analyses by ion-excited X-ray emission (IEXE). It appears possible to simultaneously perform analyses by IEXE and elastic-scattering techniques on the same sample, thus allowing total elemental analyses to be made, H through U, to good sensitivity at low cost. While either protons or alpha particles can be used effectively for either type of analyses, the rather limited velocity range that produces the best IEXE analyses (~2–6 MeV/amu) sets constraints upon simultaneous analyses using elastic scattering. If alpha beams are roughly comparable to protons for IEXE, then their much greater kinematic energy loss aids in resolving light elements by elastic scattering and encourages simultaneous analyses. Detectable limits for elemental analyses using protons and alpha particles with a velocity of 4 MeV/amu proved to be essentially the same. (auth)

2841 ABSOLUTE DETERMINATION OF TRACE QUANTITIES OF THE ^{228}Th SERIES. Cross, P.; McBeth, G. W. (Brighton Polytechnic, Eng.). Health Phys.; 27: No. 3, 265-272(Sep 1974).

Low activity levels of ^{228}Th(~ 7 pCi) were determined to ±4% in 800 min counting time. The theory of the technique is fully described and its ability to discriminate against other radioactive series was assessed. There is an indication that under favorable circumstances activities of $\sim 10^{-12}$Ci of ^{228}Th could be determined in 800 min counting time. As an example of the system in operation 7 pCi of ^{228}Th in a sample of Thorium-X(^{224}Ra) varnish was determined and a contamination level of 60 nCi ^{228}Th per ml of varnish and 2.5×10^{-4} μCi ^{228}Th per μCi ^{224}Ra established. (auth)

2842 THEORY OF THE GAMMA–GAMMA METHOD WITH LOW-ENERGY GAMMA RADIATION. Pshenichnyi, G. A.; Meier, V. A. Uch. Zap. Leningrad. Gos. Univ., Ser. Fiz. Geol. Nauk; No. 23, 208-216(1973). (In Russian).

The nature of the basic dependence of the interaction of gamma quanta of low energy, comparable to the energy of the electron bond in the atom, on the properties of the medium is theoretically evaluated. Formulas are given which can be used to determine the effective parameters of the interaction of these gamma rays with a medium of complex composition. (tr-auth)

2843 DETERMINATION OF EFFECTIVE ATOMIC NUMBER OF A MEDIUM FROM THE RATIO OF THE INTENSITIES OF NONCOHERENT AND COHERENT DISPERSION OF GAMMA RADIATION. Meier, V. A.; Pshenichnyi, G. A.; Nekhabtsev, V. S. Uch. Zap. Leningrad. Gos. Univ., Ser. Fiz. Geol. Nauk; No. 23, 216-223(1973). (In Russian).

A proposal is made to use the ratio of the intensities of coherent and noncoherent dispersion of gamma radiation in a medium to determine the effective atomic number of that medium. The coherent and noncoherent radiation may be separated by using differential filters or escape peaks of a detector. Experimental data are given which confirm the possibility of using this ratio for analytical purposes. (tr-auth)

2844 SYSTEM ANALYSIS OF GAMMA-RAY SPECTROMETRY AND A REALIZATION OF ON-LINE EVALUATION FOR ENVIRONMENTAL SAMPLE CONTROL OR OTHER PURPOSES. Winiger, P.; Huber, O.; Halter, J. (Univ., Fribourg, Switzerland). pp 380-398 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From Seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

A reliable on-line analysis system even for weak environmental samples is a dream of many health physicists. It should be as sensitive as possible, save as much time as possible, and the costs of the system should be competitive to the price of a "comparable" hardware analyzer. This implies a shielded Ge(Li)-detector of good resolution and efficiency, a computer controlled multichannel analyzer of modest size and a small peripheral equipment, a corresponding standard software for nuclear spectrometry, input and output routines and a floating point arithmetic. Accurate catalogs of gamma transitions and parametrized detection efficiency curves for as many geometric sample configurations as needed are basic to any evaluation system. A detailed task analysis of gamma spectra evaluation was made and is summarized in the paper. Applications to environmental samples are presented. (auth)

2845 RADIORELEASE DETERMINATION OF THE CORROSION RESISTANCE OF DENTAL METAL WIRES. Tolgyessy, J. (Slovak Technical Univ., Bratislava); Lukac, P.; Blada, J.; Klehr, E. H. Radiochem. Radioanal. Lett.; 19: No. 3, 217-222(25 Oct 1974).

A radio-release method was developed to study the corrosion resistance of materials used for dental wires. Kryptonated samples were exposed to solutions of various pH values, and the decrease in activity of the wire was followed as a function of time. The corrosion resistance of Osteofix, Wipla, Remanit, and Rubo wires was studied at various pH values. (auth)

2846 DETERMINATION OF BORON AND CADMIUM BY NEUTRON ABSORPTION. Eichholz, G. G.; Hendrix, W. A. (Georgia Inst. of Tech., Atlanta). Radiochem. Radioanal. Lett.; 19: No. 3, 157-161(25 Oct 1974).

Measurements of the boron and cadmium content of various media suspended in water were obtained by measuring the transmission loss of neutrons from a californium source. Adequate accuracy and reproducibility were obtained when the system was calibrated by known solutions. (auth)

2847 SIMPLE METHOD FOR COMBUSTION OF FAECAL SAMPLES PRIOR TO LIQUID SCINTILLATION COUNTING. Arnfred, T.; Fogh, K.; Pedersen, L. (Aalborg Sygehus Nord, Denmark). Scand. J. Gastroenterol.; 9: No. 4, 325-326(1974).

A cheap apparatus for combustion of 0.5 g fecal samples is described. The $^{14}CO_2$ and $^{3}H_2O$ produced is absorbed in a mixture of phenylethylamine, ethanol, and water, which can be mixed with a toluene liquid scintillator for counting. ^{14}C-recovery is 94 to 101% and ^{3}H-recovery is 89 to 99%. (auth)

2848 RADIOISOTOPE X-RAY FLUORESCENT DETERMINATION OF HAFNIUM IN ZIRCONIUM MINERALS (EXCHANGE OF EXPERIENCE). Bochenin, V. I. Ind. Lab. (USSR) (Engl. Transl.); 40: No. 4, 510(Apr 1974).

Translated from Zavod. Lab., 40: No. 4, 408(Apr 1974).

The possibility of a quantitative determination of hafnium in zirconium minerals using the ^{57}Co isotope, which emits γ radiation having an energy of 122 keV, is described. The characteristic radiation of the K series of Hf (E = 65 keV), excited with ^{57}Co photons, is recorded with a scintillation detector having NaI(Tl) crystal in combination with a Mineral-3 amplitude analyzer. The sensitivity of determination of hafnium amounted to 0.1–0.2%, and the relative root-mean-square error was 12%. (LK)

2849 MEASUREMENT OF THE ASH CONTENT OF COAL FROM THE FORWARD SCATTERING OF BETA RADIATION. Klempner, K. S.; Parkhomenko, V. V. (Donets Scientific-Research Coal Inst., USSR). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 4, 525-527(Apr 1974).

Translated from Zavod. Lab., 40: No. 4, 421–423(Apr 1974).

Some preliminary experimental results on the use of the forward scattering of β radiation from a $^{90}Sr + ^{90}Y$ source for measuring the ash content of coal are presented. The essence of the test method based on the "forward" scattering of radiation lies in measuring the flux scattered from the material onto a radiation detector having a radiator-detector geometry bilateral with respect to the sample, but smaller than 180°. Results show that the measurement of ash content by reference to the forward scattering of β radiation gives approximately the same sensitivity as the backscattering method, at the same time reducing the error in the results of the measurements associated with fluctuations in the iron compound content of the inorganic part of the coal by a factor of five. (LK)

2850 USE OF ION-INDUCED X-RAYS FOR SPECTROCHEMICAL ANALYSIS. Kamada, H. (Tokyo Univ.); Terasawa, M. Anal. Chim. Acta; 71: No. 2, 303-310(Aug 1974).

The application of ion-induced x rays to spectrochemical analysis was examined by means of a dispersive method with a flat crystal and a 200-kV ion accelerator. For x rays of longer wavelength than 10 Å, x-ray count rates of the order of 10^4–10^5 cps were obtained; the use of heavy ions, such as Kr^+, Ne^+, and 0^+ was shown to be effective for x rays shorter than about 30 Å, while protons were more efficient for longer wavelengths. X-ray excitation efficiencies were almost independent of the anionic shell with which the x rays are associated and are dependent on wavelength only, indicating that almost all elements can yield K, L or M x rays of considerable intensity. The x-ray excitation method by proton and heavy ion bombardment was applied to the determination of some light elements, F, O, N, and Be. Detection limits of 10 ppm could be readily achieved for these elements. (NL)

2851 COMBUSTION APPARATUS FOR PREPARING SAMPLES FOR LIQUID SCINTILLATION COUNTING. (to Nuclear Chicago Corp.). Netherlands Patent A7,216,262. 30 Nov 1972. Priority date 1 Dec 1971, USA. 13p. (In Dutch).

Many different methods of combustion were used to produce oxidation products of ^{14}C, ^{35}S, or ^{3}H compounds. However, the oxygen flask combustion technique developed by W. Schoniger is preferred. An improvement of the Schoniger apparatus is provided herein making lower combustion temperatures possible. Ignition of the sample is maintained without the addition of foreign combustible material of non-sample origin by means of a high-intensity continuous spark and the resulting formation of reactive ozone and singlet oxygen. (NL)

2852 DATA PROCESSING OF TRIPLE LABELLED LIQUID SCINTILLATION SAMPLES. Veen, H. (Centre for Plant Physiological Research, Wageningen, Netherlands). Int. J. Appl. Radiat. Isotop.; 25: No. 8, 355-359(Aug 1974).

Procedures to analyze liquid scintillation samples containing ^{3}H, ^{14}C and ^{36}Cl are described. An off-line desk computer was used for data processing. Quench correction was made with the external standard channels ratio method. (auth)

2853 CONTRIBUTION TO THE DEVELOPMENT OF THE X-RAY SPECTROSCOPY EXCITED BY β-RAYS EMITTED BY RADIOISOTOPES. Voljin, V. (Univ., Bucharest). Stud. Cercet. Fiz.; 26: No. 3, 283-311(1973). (In Rumanian).

The following topics are discussed: comparison of the x-ray spectroscopy with tubes and radioisotopes; intensity of the characteristic x rays excited by β rays; contribution of internal bremsstrahlung, N_{EB}; contribution of internal bremsstrahlung N_{1B}; intensity of the characteristic x rays excited by photoelectric absorption of bremsstrahlung N_{PH}; intensity of the characteristic x rays excited by direct interaction of β rays N_β; experimental measurements; source preparation; preparation of radiators; spectra analysis; comparison of theoretical and experimental spectra; some problems of x-ray spectroscopy using β rays; choice of β-active isotopes and source preparation; choice of optimal detection conditions and determination of x-ray characteristic peak shape; and qualitative and quantitative analysis with characteristic x rays excited by β rays. (auth)

2854 STATISTICS OF LOW LEVEL COUNTING. Low Level Counting of ^{3}H AND ^{14}C. Saro, S. (Komenskeho Univ., Bratislava). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; 13: 131-143(1973).

The basic statistical lows of counting of low level activity are given. Counting time with respect to counting precision is discussed and an expression is given for the counting time in the most general form. Expressions for the minimum observable counting rate and for the maximum dating age by radiocarbon dating are given in very practical forms. The problem of a general equation to express the specific tritium activity of water, which is measured in different forms is discussed. (auth)

Separation Procedures

2855 (JUL-1089-CT) TREATMENT OF VOLATILE RADIONUCLIDES IN FUEL ELEMENT REPROCESSING PLANTS. Boehnert, R. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Chemische Technologie). Jul 1974. 25p. (In German). Dep. NTIS (US Sales Only) $4.25.

The most important volatile radionuclides occurring in fuel reprocessing plants are listed. The release sites and release rates for the rare gases, iodine, and tritium are noted. Methods used for gas purification in reprocessing plants are briefly described. These include separation of aerosols from waste gas, separation of condensable radioactive steam, and separation of radioactive rare gases from the waste gas flow. Rare gas separation by the use of membranes, selective absorption in liquids, adsorption on solids, and cryogenic distillation is described. The final deposition of volatile radionuclides is briefly reviewed. (JSR)

2856 (NBL-272, pp 74-77) AUTOMATED MINI ION-EXCHANGE SYSTEM (AUTOSEP). Weiss, J. R.; Wenzel, A. W.; Pietri, C. E. Oct 1974.

In annual progress report for the period July 1973 through June 1974.

2857 EFFECT OF pH ON THE KINETICS OF ADSORPTION OF IODIDE AND COBALT(II) IONS ON METALLIC AND GLASS SURFACES. Mehta, O. P. (Univ. of Udaipur, India). Indian J. Chem.; 12: No. 3, 315-319(Mar 1974).

Adsorption kinetics of I^- ($+^{131}I$) ions on copper, silver, gold, platinum, nickel, stainless steel, and glass and of Co^{2+} ($+^{58}Co$)

ions on aluminum from their solutions of pH varying from 1.4 to 10.5 have been investigated. In general on all metallic surfaces, a marked variation in adsorption rate is observed with an increase in the pH. The results are interpreted on the basis of relative absorbabilities of H^+/OH^- ions and of the anions/cations under study. The presence of an excess H^+ ions in acidic range facilitates whereas that of OH^- ions in alkaline range retards the adsorption of I^- ions. The deposition behavior of ions does not appear to have a direct relationship with electrochemical potential of the surfaces. The effect of added Cl^- and CO_3^{2-} ions on the deposition behavior of I^- ions is also discussed. (auth)

2858 ASSESSMENT OF POTASSIUM ZINC FERROCYANIDE AS AN ALKALI-METAL ION-EXCHANGER IN ION-SELECTIVE ELECTRODES. Fogg, A. G.; Pathan, A. S.; Burns, D. T. (University of Tech., Loughborough, Eng.). Anal. Lett.; 7: No. 8-9, 539-543(1974).

Silicone rubber membranes containing potassium zinc ferrocyanide were assessed as ion-selective electrode sensors for the determination of alkali metal ions. The slope of the calibration graph for potassium ion is 59 mV per decade change in concentration within the concentration range 5×10^{-4} to 10^{-1} M at 25°C. Selectivity constants (K_{K^+/M^+}) are 9.5, Cs^+; 3.3, Rb^+; 0.025, Na^+; 0.003, Li^+; and 1.8, NH_4^+, calculated from potential data obtained at 10^{-1} M concentrations of each ion separately. Similar membranes prepared from PVC responded similarly with a slight improvement in selectivity. (auth)

2859 SELECTIVE FOAM SEPARATION OF THE OXYANIONS OF V(V), Cr(VI), Mo(VI), W(VI), and Re(VII) FROM MULTICOMPONENT SYSTEMS. Charewicz, W.; Grieves, R. B. (Univ. of Kentucky, Lexington). J. Inorg. Nucl. Chem.; 36: No. 10, 2371-2375(Oct 1974).

An experimental investigation is presented of the batch foam separation of the oxyanions of V(V), Cr(VI), Mo(VI), W(VI), and Re(VII) from 1.0×10^{-6}M (in each metal oxyanion) mixed aqueous solutions, with the cationic surfactant, hexadecyldimethylbenzylammonium chloride. For each experiment, five replicate points are reported, with a different metal monitored by a radiotracer and gamma spectrometry in each replicate. The effects of H^+ on the acid-base equilibria of the oxyanions and the effect of Cl^- competition with each oxyanion for the surfactant were established by varying the HCl concentration of the initial solutions from 10^{-5} to 3.0×10^{-1}M. The maximum flotation of each oxyanion (from the mixture of all five), the average flotation rate, and a separation factor describing the relative selectivity of the surfactant for each possible pair of metal oxyanions are related to the HCl concentration. At an HCl concentration of 10^{-3}M, Re can be satisfactorily foam separated from Cr, W, and/or V, Mo from Cr, W, and/or V, Cr from W and/or V, and W from V. A selective batch flotation system could be designed on the basis of ion pair formation constants and the oxyacids' dissociation equilibria, although ion complexation might affect the predicted results. (auth)

2860 CRYSTALLINE INSOLUBLE ACID SALTS OF TETRAVALENT METALS. XVIII. Ion Exchange Properties of Crystalline $ZrNaH(PO_4)_2 \cdot 5H_2O$ Towards Alkali Metal Ions. Alberti, G.; Constantino, U.; Gupta, J. P. (Perugai Univ., Italy). J. Inorg. Nucl. Chem.; 36: No. 9, 2103-2107(Sep 1974).

The ion exchange behavior of crystalline $ZrNaH(PO_4)_2 \cdot 5H_2O$ towards alkali metal ions has been investigated. It was found that, in the pH range 3 to 5, hydrogen ion is not exchanged and only Na^+-alkali metal ion exchange takes place. Forward and reverse Na^+-K^+, Na^+-Li^+, K^+-Li^+ and Na^+-Cs^+ ion exchange isotherms have been determined and discussed comparatively with the results obtained previously with fully-substituted alkali metal ionic form of zirconium phosphate. The exchanges occur with phase transitions and small hysteresis loops have been observed between the isotherms of the two opposite processes. The sequence of decreasing alkali metal ion preference is $K^+ > Cs^+ > Na^+ > Li^+$ and a very high selectivity towards K^+ or Cs^+ ion has been found. Thus, differently from $Zr(HPO_4)_2 \cdot H_2O$, the monosodium form exhibits preference for large cations and this different behavior may be due to the large difference in the interlayer distances of the two ionic forms (7.56 and 11.8 Å respectively). The uptake of large ions by enlarged crystalline zirconium phosphate discloses new practical applications for such an exchanger. (auth)

2861 EXTRACTION OF URANIUM(VI) FROM HYDROCHLORIC ACID SOLUTIONS BY TRI-N-OCTYL PHOSPHINE OXIDE. Sato, T.; Nishida, T. (Shizuoka Univ., Hamamatsu, Japan). J. Inorg. Nucl. Chem.; 36: No. 9, 2087-2089(Sep 1974).

The distribution of uranium(VI) between hydrochloric acid solutions and kerosene solutions of tri-n-octyl phosphine oxide (TOPO) was investigated. The absorption spectra of both the aqueous and organic phases were examined, and the ir and NMR spectra of the organic phases were studied. (auth)

2862 SYNERGISTIC SOLVENT EXTRACTION OF RARE-EARTH METAL IONS WITH THENOYLTRIFLUOROACETONE ADMIXED WITH TRIBUTYLPHOSPHATE. Farbu, L.; Alstad, J.; Augustson, J. H. (Univ. of Oslo). J. Inorg. Nucl. Chem.; 36: No. 9, 2091-2095(Sep 1974).

Extraction equilibrium constants were determined for the formation of mixed complexes of thenoyltrifluoroacetone (HTTA) and tri-n-butyl phosphate (TBP) with all the rare earths except La and Eu, but including Y. The organic diluent was carbon tetrachloride containing 0.2 M HTTA initially and the aqueous phase was kept at constant ionic strength with 1 M $(H,Na)ClO_4$. Equilibrations of the phases were performed at (23 ± 2)°C. The logarithms of the extraction constants, log $K^*_{3,1}$ and log $K^*_{3,2}$, together with the calculated logarithms of the formation constants of complexes between tris-TTA chelates and TBP in the organic phase, log $\beta_{3,1}$ and $\beta_{3,2}$ are summarized. The variation of log $K^*_{3,n}$ and log $\beta_{3,n}$ with atomic numbers, Z, shows interesting tetrad effects. (auth)

2863 CRYSTALLINE INSOLUBLE ACID SALTS OF TETRAVALENT METALS. XIX. Na^+-catalyzed H^+-Mg^{2+} and H^+-Cs^+ Ion Exchanges on α-zirconium Phosphate. Alberti, G.; Constantino, U.; Gupta, J. P. (Perugai Univ., Italy). J. Inorg. Nucl. Chem.; 36: No. 9, 2109-2114(Sep 1974).

The effect of variable amounts of Na^+ ion on the H^+-Mg^{2+} and H^+-Cs^+ ion exchange systems, by using crystalline $Zr(HPO_4)_2 \cdot H_2O$ as an exchanger, is reported. It was found that the Mg^{2+} ion is negligibly exchanged by $Zr(HPO_4)_2 \cdot H_2O$ even at pH 10. On the contrary, in the presence of small amounts of added Na^+ ion, Mg^{2+} is easily exchanged and a well defined plateau of exchange at about pH 3.3 is obtained. The presence of Na^+ ion also considerably influences the H^+-Cs^+ exchange. Structural changes of the exchanger at the various degrees of Mg^{2+} or Cs^+ loadings were examined by means of the X-ray powder diffraction. The effect of the sodium ion resembles that of a catalyst since H^+-Mg^{2+} and H^+-Cs^+ exchanges are strongly influenced by the presence of small amounts of Na^+ ion but Na^+ does not compare in the global ion exchange reactions. A possible mechanism for the catalytic effect of the Na^+ on the exchange of large ions by $Zr(HPO_4)_2 \cdot H_2O$ is reported, and potential applications of this effect on the exchange of large cations by crystalline $Zr(HPO_4)_2 \cdot H_2O$ are discussed. (auth)

2864 CHELATING ION-EXCHANGE RESINS CONTAINING KETOIMINOCARBOXYLIC ACIDS AS FUNCTIONAL GROUPS. Marhol, M.; Cheng, K. L. (Univ. of Missouri, Kansas City). Talanta; 21: No. 7, 751-762(Jul 1974).

A series of ion-exchange resins containing $-COCH_2N[(CH_2)_m COOH_2]_2$ groups was synthesized. Additional analogues were prepared by means of the reaction of the carbonyl group with phosphorus trichloride or thioglycolic acid. The properties of these resins and the selectivity for different metal ions (including Th, U, La, Sr, Cd) were also investigated. (auth)

2865 CARBOXYLIC ACIDS AS METAL EXTRACTANTS. Miller, F. (Univ. of Aberdeen, Scotland). Talanta; 21: No. 7, 685-703(Jul 1974).

One of the problems in the extraction of trace elements is that matrix elements must usually be masked, involving the addition of large amounts of extra reagent and thus increasing the risk of contamination. If the matrix element is to be removed, an extraction system of high capacity is needed to avoid dilution effects. In this respect, long-chain or substituted carboxylic acids show great promise. A literature review on their use as metal extractants is presented. The metals extracted include U, Th, Zr, Nb, rare earth metals, In, Te, V, Cd, Y, Sc, Ce, Sr, Be, Ru, Cs. (auth)

2866 PURIFICATION OF RADIOACTIVE WATER FROM ^{60}Co BY REVERSE OSMOSIS. Maksudov, E. Kh.; Abdusalyamov, N.; Shaposhnikova, S. T.; Aikhodzhaev, B. I. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 4, 26-27(1974). (In Russian).

Experiments were carried out on a solution containing 4.2×10^{-6} mol/l Co-60 and having a specific activity of 5.4×10^{-8} Ci/l at room temperature and a solution pH of 6.5 to 8. Filtration through a semipermeable cellulose membrane was done on a laboratory unit at 60 to 70 atm. The activity of the filtrate and initial solutions were measured by evaporating down 250 ml of water and counting the 1.17 and 1.33 MeV γ photopeaks on a multichannel analyzer equipped with a NaI(Tl) crystal. The data show that greater than 99.6% of the Co-60 concentrates in the salt-rich fraction. Under these same conditions it is found that 96% NaCl concentrates in the salt-rich fraction from a 10 g/l NaCl solution. By filtering through a semipermeable membrane it is possible to separate almost completely the radioactive Co-60 from the water. (SJR)

2867 EFFECT OF ALCOHOL ON PRIMARY AMINE EXTRACTION OF Ti and Zr FROM SULFATE SOLUTION. Shevchuk,

I. O.; Shevtsova, L. I.; Kapkan, L. M. (Kiev Polytechnic Inst.). Ukr. Khim. Zh.; 40: No. 1, 70-74(Jan 1974). (In Ukrainian).

The effect of aliphatic alcohols on the extraction of Ti and Zr by chloroform solutions of primary amines, $C_{10}-C_{12}$, was studied. Zirconium extraction was not affected by the type of alcohol. The Ti sulfate complex was extracted by a chloroform solution of $C_{10}-C_{12}$ amines merely by addition of aliphatic alcohols, but with increase in the length of the alkyl chain of the alcohol, the extraction was somewhat decreased. NMR spectra showed that the alcohol OH groups react with the Ti sulfate acid complex to produce a solvate-type compound. The formation of such solvates is not typical of the Zr sulfate acid complex with $C_{10}-C_{12}$ primary amines. (tr-auth)

2868 EXTRACTION OF ELEMENTS BY ALKYLALKOXYMETHYLPHOSPHINE OXIDES. I. Extraction of some Elements by Butylbutoxymethylphosphine Oxides from Nitric Acid Solutions. Artyukhin, P. I.; Shavinskii, B. M.; Mityakin, Yu. L.; Mironova, Z. N.; Tsvetkov, E. N.; Nikolaev, A. V.; Kabachnik, M. I. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 5, 41-44(Sep 1974). (In Russian).

Extraction of series elements [Bi(III), W(VI), Mo(VI), Pd(II), Re(VII), Sn(II), Fe(III), In(III), Ir(IV), Pb(II), Au(III) and Sb(V)] by phosphine oxides of such type: $(C_4H_9)_n P(O)(CH_2OC_4H_9)_{3-n}$, n = 0 – 3, from nitric acid solutions has been studied. It has been established that distribution coefficients of elements decrease with increasing of number of butoxymethyl substitutes in the reagents molecules. Bismuth is shown to be extracted by dibutyl (butoxymetyl) phosphine oxide in form of trisolvate. (auth)

2869 EXTRACTION OF CERIUM N–BENZOYLPHENYLHYDROXYLAMINATE. Alimarin, I. P.; Sokolova, I. V.; Ustinova, L. I. (Moscow State Univ.). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 23: No. 3, 486-488(Mar 1974).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 23: No. 3, 516-519(Mar 1974).

Cerium (III) and cerium (IV) are quantitatively extracted by a benzene solution of N-benzoylphenylhydroxylamine. Regardless of the initial oxidation state of cerium, a complex compound of Ce(IV) with ratio of the components Ce : BPHA = 1:4 is present in the extract. The yellow-colored extract of cerium (III) N-benzoylphenylhydroxylaminate, possessing no absorption bands in the visible region of the spectrum, can be obtained only under conditions preventing its oxidation, namely, in the extraction of Ce(III) in an atmosphere of argon or in the extraction of Ce(III) and Ce(IV) in the presence of a reducing agent. (auth)

2870 MATHEMATICAL MODELLING OF EXTRACTION PROCESSES FOR NUCLEAR FUEL REPROCESSING. II. Investigation of the Possibility of Plutonium Accumulation During Hazardous Operation of an Extractor for Reprocessing Water–Moderated Water-Cooled Power Reactor Fuel Elements. Rozen, A. M.; Reshet'ko, Yu. V.; Zel'venskii, M. Ya. At. Energ. (USSR); 37: No. 3, 194-197(Sep 1974). (In Russian).

Using the method of mathematical modeling the authors have investigated the possibility of plutonium accumulation in an extractor up to concentrations exceeding safe values from the standpoint of criticality. It has been shown that near the limiting conditions a thirty-fold accumulation of plutonium is possible. In this case, a concentration of 10 g/l may be attained in 1.5 to 2 hours and 30 g/l in 6 to 8 hours. The results obtained should be taken into account when providing for nuclear safety of extractors. (4 figures, 6 references.) (auth)

2871 MATHEMATICAL MODELLING OF EXTRACTION PROCESSES FOR NUCLEAR FUEL REPROCESSING. I. Mathematical Model. Certain Features of the Purex Process. Rozen, A. M.; Reshet'ko, Yu. V.; Zel'venskii, M. Ya. At. Energ. (USSR); 37: No. 3, 187-193(Sep 1974). (In Russian).

Work performed to develop a mathematical model of an extraction process as applied to nuclear fuel reprocessing in apparatuses of the mixer-settler type was generalized. The model includes material balance and equilibrium equations. The proposed mathematical model is shown to adequately describe the process and can be used to obtain its static and dynamic characteristics for various values of input variables as well as to predict emergency situations. Reliable algorithms have been developed to calculate these characteristics using a digital computer. As an example, the operation of the first extractor in the Purex process has been analyzed for the case of uranium, plutonium, and nitric acid extraction by means of a TBP solution in kerosene under static as well as dynamic conditions. (7 figures, 16 references.) (auth)

2872 ABSORPTIVE EXTRACTION OF Mo(IV) FROM NITRIC ACID SOLUTIONS AND ITS SEPARATION FROM Fe(III). Vasilenko, L. V.; Kazantsev, E. I.; Fomenko, A. V.; Galitskaya, N. B.; Stebeneva, I. G. (Ural Polytechnical Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 114-117 (1974). (In Russian).

Vinyl pyridine anion exchangers have a high chemical and thermal stability in concentrated nitric acid solutions, and a macroporous structure. These resins showed a maximum absorption of Mo at a pH of 3 to 5. The extraction of Mo is effective only for anion exchangers having large pores and a well-developed internal surface because of the large size of polymerized Mo anions in acid solution. The adsorption of Mo by the anion exchanger AN-251 having a macroporous structure exceeds by a factor of almost 3 its total exchange capacity (16.85 mg-equivalents of Mo per gram of resin). The adsorbed Mo is readily eluted with 3 to 4 column volumes of 10% NH_4OH. Mo is preferably adsorbed from acid solution in the presence of Fe(III), and can thus be readily purified from iron. (SJR)

2873 USE OF THE X-RAY RADIOMETRIC METHOD FOR INVESTIGATION OF THE DYNAMICS AND KINETICS OF ION-EXCHANGE PROCESSES. Lebedev, K. B.; Shirokii, V. K.; Kryukova, E. I.; Batishchev, V. N. (Scientific-Research Inst. for Mechanical Concentration of Minerals, Alma-Ata, USSR). J. Appl. Chem. USSR (Engl. Transl.); 47: No. 4, 849-851(Apr 1974).

Translated from Zh. Prikl. Khim.; 47: No. 4, 837-840(Apr 1974).

It is shown that the x-ray radiometric method of analysis can be used for studying the space and time distribution of adsorbate ions in laboratory ion-exchange columns directly in the course of sorption processes. The family of experimental curves for the space and time distribution of the sorbed element provides information on the mechanism of sorption kinetics, the dynamic exchange capacity of the sorbent, and the sorption rate. In the course of ion-exchange sorption of ReO_4^- ions on AN-21 × 8 anion-exchange resin two waves of the sorption front were found, corresponding to bed heights of 0.25 and 0.85 (the total height being taken as 1). (auth)

Inorganic, Organic, and Physical Chemistry

2874 VIBRATIONAL REDUCED PARTITION FUNCTION OF THE MORSE OSCILLATOR. Ishida, T. (Brooklyn College of The City University of New York, Brooklyn, New York 11210). J. Chem. Phys. 61: No. 8, 3009-3016 (15 Oct 1974).

The anharmonicity correction factor for the vibrational reduced partition function of the Morse oscillator has been numerically evaluated. The effect of anharmonicity on the reduced excitation factor $u/(1-e^{-u})$ opposes the effect of $e^{ux/4}$, the usual anharmonicity correction. At all levels of anharmonicity, the former correction exhibits its maximum effects near $u=4$, where its magnitudes are not negligible compared to that of the correction for the zero–point energy factor. (auth)

Chemical and Physicochemical Properties

Refer also to abstracts 2746, 3027, 3061, 3680, 3983, and 5294.

2875 (AED-CONF-73-172-000) ANNUAL MEETING OF THE SOCIETY OF GERMAN CHEMISTS, SPECIALIST GROUP FOR WATER CHEMISTRY, BAD ZWISCHEN. (Gesellschaft Deutscher Chemiker, Frankfurt am Main (F. R. Germany)). 1973. vp. (In German). (CONF-7305103-(Absts.)).

From annual meeting of the Society of German Chemists, specialist group for water chemistry; Bad Zwischenahn, F. R. Germany (28 May 1973).

Twenty five papers are presented concerning water generally, chemical analysis and chemistry of water, lakes, surface and ground water, water pollution, water monitoring and similar subjects; especially the contribution to the oxygen household of surface waters, the spreading of beryllium in water, the radiation chemical decomposition of resistant organic pollutant substances in aqueous solutions, the water chemistry in nuclear power plants with light water reactors, and the question of coolant water for the production of energy are treated. (GE)

2876 (AED-CONF-74-08-010) RADIOCHEMICAL STUDY OF THE HYDROLYSIS OF TRI-THIONATE AND TETRA-THIONATE. Wagner, H.; Schreier, H. (Universitaet des Saarlandes, Saarbruecken (F. R. Germany). Inst. fuer Analytische Chemie und Radiochemie). 1974. 11p. (In German). (CONF-740342-4).

From meeting of lecturers in chemistry; Stuttgart, F. R. Germany (31 Mar 1974).

Polythionates specifically labelled either at the chain-S atoms or at the terminal sulfonic acid groups were used for the experiments. The hydrolysis products were separated by means of high-voltage paper ionophoresis and the paper strips scanned for activity distribution. The quantitative activity distribution was determined by liquid scintillation counting. The activity ratios of the reaction products measured at different times and different reaction temperatures allow the discussion of a reaction mechanism which proceeds via several intermediate steps. Activity ratios calculated on the basis of this mechanism agree very well with experimental data. The influence of the temperature-dependent isotopic exchange was taken into account in these considerations. (GE)

2877 (JUL-1085-RB) THERMAL PROPERTIES OF THE GASES H_2, CH_4, H_2O, N_2, CO, AND CO_2 IN THE RANGE $0°C \leq \vartheta \leq 1000°C$ 1 BAR $\leq P \leq$ 50 BAR. Harth, R. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorbauelemente). Jul 1974. 108p. (In German). Dep. NTIS (US Sales Only) $8.50.

The energy from HTR will be used for process heat in the chemical and metallurgical industry. For technical calculations and for evaluation of thermo- and fluid-dynamic investigations the thermal properties of the components being involved in these processes are needed. This report presents the thermal properties of H_2, CH_4, H_2O, N_2, CO and CO_2 in the range $0°C \leq \vartheta \leq 1000°C$; 1 bar $\leq P \leq$ 50 bar. Dependency on pressure and temperature is given in the form of equations. Tables of the properties are included. (auth)

2878 (RCN-213) SOLUBILITY AND ADSORPTION OF SOME ORGANO-MERCURY COMPOUNDS. van der Sloot, H. A.; Blomberg, C.; Das, H. A. (Stichting Reactor Centrum Nederland, Petten). Jun 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

The solubility in water and the adsorption on glass and polythene of some organomercury compounds, which are of interest in pollution studies, have been measured. (auth)

2879 SOLUBILITY OF HYDROXYMETHYLENEIMINO DIACETATES OF RARE EARTH ELEMENTS OF THE CERIUM SUBGROUP. Khramov, V. P.; Bogacheva, A. L. (Saratov Inst. for Mechanization of Agriculture, USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 8, 1250-1251(1974). (In Russian).

Solubilities were determined for rare earth salts having the composition $Ln(HA)_3 \cdot nH_2O$, where n = 4 for compounds of La, Ce, Pr, and Nd, and 2 for Sm. These compounds are poorly soluble in water with the solubility decreasing on going from La to Sm. Temperature increases also decreases the solubility. The solubility product increases from 7×10^{-11} for the lanthanum salt to 1.5×10^{-8} for the samarium salt. (SJR)

2880 THERMODYNAMIC STUDY OF THE SYSTEM LITHIUM-HYDROGEN UTILIZING A MASS SPECTROMETRIC KNUDSEN EFFUSION METHOD. Ihle, H. R.; Wu, C. H. (Kernforschungsanlage, Juelich, Ger.). J. Inorg. Nucl. Chem.; 36: No. 10, 2167-2170(Oct 1974).

The thermodynamic properties of the system Li-H were investigated by the mass spectrometric Knudsen effusion method in the "plateau region" between 700 and 873°K. The enthalpy of the reaction LiH(s. sat. with Li) → Li(l. sat. with LiH) + 1/2 H_2(g) was determined. The resulting equilibrium pressure for hydrogen in the "plateau region" defined by this temperature range is given by the equation: $\log p(\text{torr}) = -[(1.040 \pm 0.021) \times 10^4/T] + 13.30 \pm 0.26$. The average standard enthalpy, and free energy of formation of LiH are: $\Delta H^0_{298} = -21.8 \pm 0.5$ kcal/mole, $\Delta G^0_{298} = -16.77 \pm 0.5$ kcal/mole. (auth)

2881 COMPLEXING OF VANADIUM(V) WITH A NUMBER OF GOSSYPOL DERIVATIVES. Talipov, Sh. T.; Chaprasova, L. V.; Urmanov, N.; Tashkhodzhaev, A. T.; Inoyatov, A. (Tashkent State Univ.). Dokl. Akad. Nauk Uzb. SSR; No. 4, 37-38(1974). (In Russian).

This study presents the results of a comparative analytical investigation of vanadium (V) complexing with isonicotinoylhydrazone-gossypol (R_1) and isonicotinoylhydrazone-(diethoxy)-gossypol (R_2). In the experiments 0.1 and 0.04% solutions in ethyl alcohol and n-butyl alcohol were used respectively as prepared by precise weighing. The standard vanadium solution forms an orange-red complex with R_2 in butyl alcohol ($\lambda_{max} = 470$ mm). The molar extinction coefficients with the reagents R_1 and R_2 were 17,700 and 8900 respectively as calculated from absorption spectra. The optimum pH for complexing and extracting was 3 for R_1 and 2.5 for R_2 in acetate-hydrochloric buffered solutions. The extracts are stable with time. The degree of extraction of vanadium into the organic phase as a result of a single extraction with the reagents R_1 and R_2 was 97 and 92% respectively, while the distribution coefficients were 64.7 and 23.5 at a water-organic phase ratio of 2:1. A simple 1:1 complex is formed. The R_2 complex is more stable than the R_1 complex. It is of practical interest that it is possible to determine vanadium with R_2 in the presence of titanium (1:5), molybdenum (1:15), zirconium (1:30), tungsten (1:20), iron (1:50), copper (1:20), chromium (1:100), nickel (1:40), cobalt (1:60), aluminum (1:50) and niobium (1:20) with the use of masking agents such as citric acid and sodium pyrophosphate. Satisfactory results were obtained in the analysis of minerals. (SJR)

Isotope Effects

Refer also to abstract 2980.

2882 (COO-2192-10) DEUTERIUM ISOTOPE EFFECTS IN ELECTRONIC RELAXATION OF LARGE POLYATOMIC MOLECULES. Progress Report, October 1, 1973-September 30, 1974. Lim, E. C. (Wayne State Univ., Detroit, Mich. (USA)). 1974. Contract AT(11-1)-2192. 7p. Dep. NTIS $4.00.

Position-dependence of deuterium isotope effects in radiationless transitions of dibenzoquinoxaline suggests the importance of vibronically active C-H out-of-plane modes in radiationless deactivations of aromatic molecules with non-bonding electrons, while the excess energy and deuteration dependence of radiationless decay rate in isolated naphthalene and anthracene suggest importance of $S_1 \rightarrow S_0$ internal conversion and slowness of vibrational energy redistribution in molecules with modest amounts of excess vibrational energy. (auth)

2883 DIELECTRIC LOSSES OF DEUTERATED CRYSTALS OF THE TGS (TRIGLYCINE SULFATE) GROUP. Pupkevich, P. A.; Varikash, V. M. (Minsk Radiotechnical Inst.). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 4, 121-123(1974). (In Russian).

This study presents the results of investigating dielectric losses of partially deuterated crystals of TGS (triglycine sulfate), TGSel (triglycine selenate) and TGFB in a strong electric field. It was found that two maxima occur on the temperature dependence tg $\delta = f(T)$ for the deuterated crystals. One maximum is lower than the Curie temperature of the deuterated crystal, and the other is in the region of the Curie point of the simple crystal. The losses were investigated as a function of the variable field. (SJR)

2884 DIFFUSION AND SOLUBILITY OF HYDROGEN AND DEUTERIUM IN THE GROUP VB TRANSITION METALS. Steward, S. A. Tempe, AZ; Arizona State Univ. (1974). 167p. University Microfilms Order No. 74-20,835.

Thesis (Ph. D.).

A newly developed dilatometric technique was employed to measure the diffusion coefficients of hydrogen in tantalum with subsequent calculation of the activation energies, which experiments showed were concentration independent. An analysis of interstitial and atomic sites of body- and face-centered cubic structures is presented with regard to certain interesting polyhedra. Also the presence of a heretofore unrecognized triangular interstitial site is discussed including its possible importance to diffusion. Results of solubility isotope effect measurements of hydrogen and deuterium in niobium are given along with the derived partial thermodynamic functions for each isotope. This work is compared with similar previous work in all three Group VB metals. (Diss. Abstr. Int., B)

2885 SPECTRA AND STRUCTURE OF PHOSPHORUS-BORON COMPOUNDS. VI. Vibrational Spectra and Structure of Some Phosphine-Trihaloboranes. Durig, J. R.; Riethmiller, S.; Kalasinsky, V. F.; Odom, J. D. (Univ. of South Carolina, Columbia). Inorg. Chem.; 13: No. 11, 2729-2735(Nov 1974).

The infrared (33-3000 cm^{-1}) and Raman (20-2700 cm^{-1}) spectra of $H_3P \cdot BX_3$ and $D_3P \cdot BX_3$ (X = F, Br, I) in the solid state at −196° were recorded. The spectra were interpreted on the basis of C_{3v} symmetry and 11 of the 12 fundamental vibrations were assigned. A shift to higher frequency of the P-H stretching mode as compared to the corresponding mode in PH_3 is consistent with a shortening of this bond with coordination. A normal-coordinate calculation was carried out and the values obtained for the P-B force constants for this series of molecules are compared to the similar quantities of several other phosphorus-boron molecules. The observation of four lattice modes in solid $H_3P \cdot BF_3$ and $D_3P \cdot BF_3$ indicates that there are at least two molecules per primitive cell which give rise to in-phase and out-of-phase components of the P-B stretch. (auth)

2886 KINETICS OF THE METAL ION CATALYZED IODINATION OF 2-ACETYLPYRIDINE. Cox, B. G. (Univ. of Stirling, Scotland). J. Amer. Chem. Soc.; 96: No. 22, 6823-6828(30 Oct 1974).

The kinetics of the iodination of 2- and 4-acetylpyridine and their corresponding N-methyl derivatives were investigated. The reactions are general base catalyzed and exhibit large kinetic deuterium isotope effects (acetyl-d_3). This, together with the observed independence of the rates of iodine concentration, shows that the rate-determining step is the enolization or ionization of the C–H bond adjacent to the carbonyl group. Complex formation between 2-acetylpyridine (SH) and Zn^{2+}, Ni^{2+}, and Cu^{2+} leads to large rate increases, the catalytic constants for the acetate catalyzed iodination being between 5×10^3 (for $Zn(SH)^{2+}$) and 2×10^5 (for $Cu(SH)^{2+}$) times larger than that of the uncomplexed substrate. This effect, which is considerably larger than that observed on protonation of 2-acetylpyridine (ca. 200-fold rate increase), is consistent with stabilization of the negative charge developing on the carbonyl oxygen during ionization of the C–H bond. (auth)

2887 GENERAL-BASE CATALYSIS OF SILICON–OXYGEN BOND CLEAVAGE. Hidden Isotope Effects. Modro, A.; Schowen, R. L. (Univ. of Kansas, Lawrence). J. Amer. Chem. Soc.; 96: No. 22, 6980-6982(30 Oct 1974).

The methoxide-catalyzed methanolyses of p-chlorophenoxytriphenylsilane and of p-methoxyphenoxytriphenylsilane, reactions previously shown to occur with general-base catalysis, proceed in mixtures of CH_3OD (mole fraction n) and CH_3OH (mole fraction 1 – n) at 25° with second-order rate constants described by $k_n = k_0(1 - n + n\phi^*)(1 - n + n\phi_m)^2/(1 - n + 0.74n)^3$, where $k_0 = 13{,}600$ M^{-1} min^{-1} (p-Cl) and 2710 M^{-1} min^{-1} (p-CH_3O). Values of $\phi^* = 0.25-0.50$ and $\phi_m = 0.8-1.2$ are consistent with the data for both compounds. These relations show that one proton in each transition state is generating a considerable isotope effect (k_H/k_D= 2–4), which is being nearly cancelled by inverse isotope effects from reactant and possibly transition-state solvation shells. Thus the observed net solvent isotope effects are only 1.25 (p-Cl) and 1.16 (p-CH_3O). (auth)

2888 DEUTERIUM ISOTOPE EFFECTS IN ZERO–FIELD SPLITTINGS OF ORIENTED TRIPLET STATES OF 1,2;5,6–DIBENZANTHRACENE, PHENANTHRENE, AND NAPHTHALENE. Cullick, A.S.; Gerkin, R.E.; Thorsell, D.L.; Winer, A.M. (Department of Chemistry, The Ohio State University, Columbus, Ohio 43210). J. Chem. Phys. 61: No. 8, 3450-3458 (15 Oct 1974).

Changes in the zero–field splitting parameters of phosphorescent 1,2;5,6–dibenzanthracene, phenanthrene, and naphthalene oriented in single–crystal hosts have been determined at temperatures near 77°K upon perdeuterating the phosphorescent molecules, the host molecules, or both. Through control and determination of appropriate experimental variables these changes have been shown to arise strictly from the isotopic substitution. For the naphthalene–biphenyl and phenanthrene–biphenyl systems readily measurable changes were observed upon isotopic substitution of either guest or host molecules. The data support the distinction of "guest" and "host" isotopic effects for zero–field splitting parameters, but definitive analysis of the origin of these effects awaits further work. (auth)

2889 STUDY OF INTERMOLECULAR INTERACTIONS IN DIOXANE–WATER AND DIOXANE–DEUTERIUM OXIDE SYSTEMS. Jaffer, S. Washington, DC; American Univ. (1974). 194p. University Microfilms Order No. 74-21,696.

Thesis (Ph. D.).

The infrared and near-infrared spectra, the densities, the volume changes and the viscosities of seventeen solutions of dioxane in water and eighteen solutions of dioxane in deuterium oxide were measured. The frequency shifts of thirteen fundamental and eleven combination bands of dioxane and the frequency shift of one fundamental and one combination band of both water and deuterium oxide were determined. The data indicate that dioxane, through the agency of hydrogen (deuterium) bonding, forms association complexes with these liquids and their structures are dioxane $\cdot(H_2O)_5$ and dioxane $\cdot(D_2O)_2$. Discontinuities in the spectral shift curves were correlated with the extremum values in the bulk properties of the solutions. (Diss. Abstr. Int., B)

2890 DEUTERIUM ISOTOPE EFFECTS AND ORIENTATION IN BIMOLECULAR ELIMINATION REACTION. Allaway, J. R. Coral Gables, FL; Univ. of Miami (1974). 146p. University Microfilms Order No. 74-23,382.

Thesis (Ph. D.).

This study reports the primary deuterium isotope effect for the formation of 1-hexene in the dehydrohalogenation of 2-bromo- and 2-iodo-1-^{2}H-hexane with potassium alkoxide bases in alcoholic solvents. The alkoxide-alcohol solutions included 1.0 M methoxide-methyl alcohol, 1.0 M isopropoxide-isopropyl alcohol, 1.0 M sec-butoxide-sec-butyl alcohol, and 1.0 M and 0.30 M tert-butoxide-tert-butyl alcohol. Dehydrohalogenation of the iodo-compound was also carried out using 0.52 M tert-butoxide in THF, and for both the iodo- and bromo-compounds with 0.32 M tert-butoxide in DMSO. Further, the reaction of the bromo-compound with varying concentrations of tert-butoxide in tert-butyl alcohol was examined in order to study the influence of concentration-dependent effects on the isotope effect. A plot of the free energy differences between transition states leading to Hofmann and Saytzev olefins ($\Delta\Delta G^{2+}$ (H/S)) vs. the corresponding free energy differences for formation of cis- and trans-2-hexene ($\Delta\Delta G^{2+}$(t/c)) for all systems studied demonstrates a smooth and continuous correlation for the data determined in alcoholic solvents but comparatively divergent values for data determined in aprotic solvents. The authenticity of the values of positional orientation measured by the free energy difference $\Delta\Delta G^{2+}$(H/S) and the values of the isotope effect are suggested by the nearly linear correlation of $\Delta\Delta G^{2+}$(H/S) and log ϵ (dielectric constant of the solvent alcohol) and the correlation of log (k_H/k_D) and H_- (especially for the iodo-compound). These results are in contrast with the relatively unsatisfactory correlation of $\Delta\Delta G^{2+}$(H/S) and log (k_H/k_D). These results indicate that the transition states leading to the internal and external olefins respond differently to the nature of the base: the internal olefin is apparently more sensitive to the steric requirements of the effective base than is the transition state leading to the external olefin, which, in turn, responds more efficiently to changes in base strength of the alkoxide-alcohol solution. In order to investigate the consequences of alkoxide-alcohol concentration-dependent phenomena (base association) on isotope effect and orientation, the dehydrohalogenation of the bromo-compound was also carried out employing a concentration gradient (0.1 M to 1.0 M) of tert-butoxide in tert-butyl alcohol. The relationship between positional orientation, geometric isomerism, and the isotope effect for formation of the external olefin (1-hexene) in these reactions is similar to those relationships in reactions (vide supra) carried out using different alkoxide bases and alcohols. The data suggest that with a Cβ–H bond more than half-broken in the transition state, the observed increase in k_H/k_D with increasing alkoxide concentration could be accommodated by an argument based on increasing solution basicity (H_-), or increasing steric requirements of the effective base. An explanation of these results based on the influence of non-linearity of the Cβ–H–O couple in the transition state is also presented. (Diss. Abstr. Int., B)

2891 MICROWAVE SPECTRAL TABLES I. DIATOMIC MOLECULES. Lovas, F.J. (Institute for Basic Standards, National Bureau of Standards, Washington, D.C. 20234); Tiemann, E. J. Phys. Chem. Ref. Data 3: No. 3, 609-769 (Sept 1974).

All of the rotational spectral lines observed and reported in the open literature for 83 diatomic molecules have been tabulated. The isotopic molecular species, assigned quantum numbers, observed frequencies, estimated measurement uncertainty, and reference are given for each transition reported. In addition to rectifying a number of misprints and errors in the literature cited, the spectral lines for approximately 20 molecules have been reanalyzed to produce a comprehensive and consistent analysis of all the data extracted from various literature sources. The derived molecular properties, such as rotational constants, hyperfine structure constants, electric dipole moments, rotational g–factors and internuclear distances are listed with one standard deviation uncertainties for all species. (auth)

2892 INTERFACIAL ISOTOPE EFFECT. Neuman, R. D. (Univ. of Minnesota, St. Paul). Nature (London); 250: No. 5469, 725-726(30 Aug 1974).

It is stated that ^{14}C is commonly used to "tag" compounds in interfacial studies, and it has been assumed that the radioactive surfactant behaves exactly like the untagged compound. During studies of condensed monolayers at the water-air interface, however, a significant kinetic isotope effect was observed in the stability behavior. Some experimental work is described using stearic acid 1- ^{14}C/inactive stearic acid deposited from hexane spreading solution on to either Ca-free or Ca Cl_2 sub-solutions. The monolayers were compressed to a surface pressure of 31mN/m with an automatically recording Langmuir-type film balance designed for constant pressure operation, and an indication of the monolayer stability was obtained by determining the decrease in film area as a function of time, at constant surface pressure. It was found that the ^{14}C labeled stearic acid monolayer was more stable than the corresponding inactive monolayer, an unexpected result, attributed to a secondary kinetic isotope effect. It was also found that the rate of change of the film area decrease and the isotope effect ($^{12}C/^{14}C$) both become greater with increasing time of comparison. Mechanisms are discussed. (UK)

2893 ELIMINATION REACTIONS. IV. Heavy Atom Isotope Effects in ElcB Elimination Reactions. Fouad, F. M.; Farrell, P. G.; Abdel-Rehiem, A. G. (McGill Univ., Montreal). Tetrahedron Lett.; No. 37, 3355-3358(Sep 1974).

A report is presented on preliminary studies of the ^{14}C leaving group effects in HCN elimination from two polycyanoethanes (both of which contained a dicyanomethyl group). Isotope effects and rate data are shown for the elimination of HCN from the polycyanoethanes in methanol and methan [$^{2}H_{1}$] ol at 30°C. In some experiments the dicyanomethyl hydrogen atom was replaced by deuterium. (UK)

2894 STRONGLY HYDROGEN-BONDED MOLECULAR SOLIDS WITH HIGHLY ANOMALOUS INFRARED OH ABSORPTION. The Effect of O-Deuteration. Spinner, E. (Australian National Univ., Canberra). Aust. J. Chem.; 27: No. 6, 1149-1160 (Jun 1974).

The infrared spectra of solid isonicotinic acid (1), 6-hydroxy-2 pyridone (2) and 6-hydroxy-1-methyl-2-pyridone (3) have very intense, broad, plateau-like, OH absorption bands, centred near 1000 cm^{-1}, with prominent transmission windows. After O-deuteration these bands remain very broad but become much less intense, and the centre of gravity is shifted to higher frequencies, by c. 100-250 cm^{-1}; most of the transmission windows become much shallower, or disappear, or are replaced by ordinary bands pointing upwards. Full explanations of the deuteration effects on the transmission windows cannot be given, but it is clear that the amplitude of hydroxyl stretching must be much greater for OH than for OD. This vibration must be very highly anharmonic, and it is shown that any physically reasonable potential energy curve for it must be highly unsymmetrical. For solids (2) and (3) the potential energy hypersurface, for all stretching vibrations, may be symmetrical, with a double minimum, but no such symmetry can be present in solid isonicotinic acid. (auth)

2895 SOLVENT DEUTERIUM ISOTOPE EFFECTS IN ALCOHOLS. Alkoxide Catalyzed Racemizations of Indenes. Levin, J. O. (Umeaa Univ., Sweden). Chem. Scr.; 6: No. 2, 89-91(1974).

Two optically active alkenes, 1,3-dimethylindene and 1-methylindene, were subjected to alkoxide catalyzed racemization reactions in MeOH(D), EtOH(D), i-PrOH(D), and t-BuOH(D). The rate constant for racemization in ROH, k_{ROH}, was compared with the rate constant for racemization in ROD, k_{ROD}. The kinetic solvent isotope effect, KSIE, was defined as k_{ROH}/k_{ROD}. The KSIE's in the alkoxide ion catalyzed racemizations of (+)-1-methylindene and (+)-1,3-dimethyl-indene were all found to fall in the range 0.49–0.54 at 25.0°C. (auth)

2896 CHARACTERISTICS OF SODIUM CARBOXYMETHYLCELLULOSE (Na–CMC) IN RELATION TO THE METHOD OF ITS PREPARATION. Petropavlovskii, G. A.; Vasil'eva, G. G.; Chernova, Z. D. J. Appl. Chem. USSR (Engl. Transl.); 47: No. 4, 887-891(Apr 1974).

Translated from Zh. Prikl. Khim.; 47: No. 4, 875-880(Apr 1974).

Samples of CMC of the same degree of substitution and of polymerization but prepared by different methods may contain amorphous and crystalline fractions in different ratios, resulting in different solubilities. The reaction of alkali cellulose with sodium monochloroacetate in propanol, in absence of excess free alkali, gives CMC of the highest degree of substitution and having the highest content of accessible amorphous fraction. If this reaction is conducted in a shredder, it is accompanied by degradation of the cellulose, as the result of which the DP of the Na-CMC obtained does not exceed 500. This improves the solubility of the product and eliminates the additional operation of alkaline degradation of cellulose. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstracts 2878, 2989, 3016, and 3586.

2897 (COO–1222-62) FUNDAMENTAL STUDIES OF SEPARATION PROCESSES. Final Report. Rogers, L. B. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Chemistry). 1974. Contract AT(11-1)-1222. 12p. Dep. NTIS $4.00.

During the past ten years, work performed under this contract has opened up several new areas in the field of separation. The use of high-resolution NMR for the study of adsorbed species and how surface characteristics influenced the observed resolution were studied. The value of high-precision digitally controlled gas chromatography for studies of mass-transfer processes and for improved identification was demonstrated. The first liquid chromatography at pressures greater than 10,000 psi was carried out and its value demonstrated for studying physical-chemical changes resulting from pressure. During the past year, two different areas of gas chromatography have been explored. One dealt with isotopic separations of carbon and oxygen in carbon dioxide and in methanol. The second dealt with mass-transfer effects observed upon application of an electrostatic field to liquid crystals. In another study, supercritical fluid chromatography has been used successfully to fractionate a silicone polymer, DC-710, into more than 20 components. Finally, liquid chromatography at pressures up to 50,000 psi has met with only limited success because of chemical attack of the equipment by aqueous solutions of salt and very dilute acids. (auth)

2898 (LA-5747-MS) CALCULATION OF EQUILIBRIUM COMPOSITIONS IN EXCHANGE REACTIONS. Carstens, D. H. W. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1974. Contract W-7405-eng-36. 6p. Dep. NTIS $4.00.

A simple calculational method for deducing equilibrium mixtures in isotopic exchange reactions, in particular those involving mixed hydrogen isotope lithium hydride-hydrogen systems, is described. The method relies heavily on an approximate graphical technique. Several examples based on the Li(D,T)-DT system are discussed using assumed values of equilibrium constants for this particular system. (auth)

2899 NEW METHOD TO IDENTIFY THE REACTION INTERMEDIATES OF HYDROGEN TRANSFER OR EXCHANGE OF PROPENE BY MEANS OF MICROWAVE SPECTROSCOPY. Kondo, T.; Saito, S.; Tamaru, K. (Sagami Chemical Research Center, Sagamihara, Japan). J. Amer. Chem. Soc.; 96: No. 22, 6857-6864(30 Oct 1974).

A method was proposed to identify the intermediates or the transition of the hydrogen–deuterium exchange reaction of propene by means of microwave spectroscopic technique, determining the distribution of geometrical isomers of propene-d_1 and -d_2 formed during the course of the reaction. This method makes it feasible to identify many possible reaction intermediates: 1-propyl, 2-propyl, 1-propenyl, 2-propenyl, σ-allyl, and π-allyl intermediates as well as the transition state in the concerted mechanism. By the use of this method, the intermediate in the hydrogen exchange reaction of propene with deuteriosulfuric acid or deuteriophosphoric acid was demonstrated to be 2-propyl carbonium ion. The exchange reaction between propene and deuterium over $C_{24}K$ (potassium–graphite intercalation compound) was found to proceed through a π-allyl intermediate, and the exchange reaction between propene and deuterium oxide over bismuth molybdate (Bi : Mo =1) was also demonstrated to take place via a σ-allyl intermediate. (auth)

2900 CARBANIONS. ELECTRON TRANSFER VS. PROTON CAPTURE. I. Base-Catalyzed Hydrogen–Deuterium Exchange of Triphenylmethane in the Presence and Absence of Electron Acceptors. Guthrie, R. D.; Weisman, G. R.; Burdon, L. G. (Univ. of Kentucky, Lenington). J. Amer. Chem. Soc.; 96: No. 22, 6955-6961(30 Oct 1974).

Triphenylmethide ions from the reaction of triphenylmethane with alkoxide ions in alcohol can be trapped by aromatic nitro compounds and by oxygen. The trapping is believed to be an electron-transfer process. The efficiency of trapping relative to protonation is a function of the nature of the reaction medium. Conditions favoring tight ion pairing increase the efficiency of trapping by nitrobenzene but have the opposite effect on oxygen trapping. (auth)

2901 HYDROGEN–DEUTERIUM EXCHANGE BETWEEN η^5-$C_5H_5Rh(C_2H_4)_2$ AND AROMATIC HYDROCARBONS. Seiwell, L. P. (du Pont de Nemours and Co., Wilmington, DE). J. Amer. Chem. Soc.; 96: No. 22, 7134-7135(30 Oct 1974).

A novel isotopic hydrogen exchange between benzene-d_6 and η^5-$C_5H_5Rh(C_2H_4)_2$, (A), is reported. The exchange, which occurs at 130°, introduces deuterium into both the cyclopentadienyl and ethylene ligands. Free ethylene or ethylene-d_4 inhibit the exchange. Arenes other than benzene exchange with (A). In order of decreasing reactivity they are $C_6D_6 \geq C_5D_5N > C_6D_5NO_2 \geq C_6D_5CD_3$. A mechanism by which exchange between arenes and co-ordinated on (A) could occur is suggested. (JGB)

2902 SPUTTERED PLATINUM CATALYST FOR ISOTOPIC EXCHANGE BETWEEN HYDROGEN AND WATER. Ramasubramanian, N.; Rolston, J. H. (Chalk River Nuclear Labs., Ont.). (1974). vp.

From international symposium on characterization of adsorbed species in catalytic reactions; Ottawa, Ontario (17 Jun 1974).

Sputtering is considered as a means for preparing high surface area platium catalysts for H/D isotopic exchange between hydrogen and water vapor. This technique, although well known as a means of metal deposition, has largely been neglected as a technique for catalyst preparation. Sputtered films are adherent and can be deposited on a variety of substrates, which allows considerable flexibility in catalyst design. (auth)

2903 ISOTOPIC EXCHANGE KINETICS FOR INSOLUBLE SALT AND ION IN AQUEOUS SOLUTION. Huang, T. C.; Li, K. Y. (National Cheng Kung Univ., Tainan, Taiwan). J. Inorg. Nucl. Chem.; 36: No. 10, 2335-2340(Oct 1974).

A mathematical model is proposed for the isotopic exchange reaction between insoluble salt particle and ion in liquid solution. The exchange equation to predict exchange fraction as a function of time was derived for the mechanism containing surface exchange reaction and intraparticle diffusion. The relation of exchange fraction and dimensionless time was calculated by computer with the ratio of forward surface exchange rate to intraparticle diffusion rate, ξ_1, and final fractional uptake, U, as parameters. The theoretical equation proposed in this study is checked with the experimental results of isotopic exchange reaction of ion and insoluble salt in aqueous solution using radioisotope as tracer. (auth)

2904 ISOTOPIC EXCHANGE BETWEEN ^{204}Tl(I) and Tl(III) IN VARIOUS SOLVENT MIXTURES. Cecal, A.; Schneider, I. A. (Univ., Iasi). Inorg. Nucl. Chem. Lett.; 10: No. 11, 977-982(Nov 1974). (In German).

Reaction kinetics and thermodynamic parameters of the isotopic exchange between ^{204}Tl(I) and Tl(III) in the following solvents: water–methanol, water–ethanediol, and water–DMSO are reported. (UK)

2905 SEPARATION OF HYDROGEN ISOTOPES BY HEATLESS ADSORPTION. Weaver, K.; Hamrin, C. E. (Univ. of Kentucky, Lexington). Chem. Eng. Sci.; 29: No. 9, 1873-1882(Sep 1974).

A hydrogen stream containing 5.5% deuterium has been continuously separated using a single staged heatless adsorber packed with metallic palladium deposited on alumina. Enrichments of up to 17.5 per cent have been achieved. Eleven heatless adsorption runs were made to examine the effect of the purge to feed ratio and cycle time. A Mass Balance Model was developed which correctly predicted the effect of these parameters on separation. Additional runs were made to determine breakthrough at the two operating pressures of 19.7 and 114.7 psi. As the purge to feed ratio, γ, increased from 0 to 3.0 better separations were achieved although the quantity of product decreased. A critical value of γ appeared to be in the range 1.0 to 1.2. As the cycle time increased from 1 to 8 min, the quantity of product increased, but the magnitude of the separations decreased. (auth)

2906 INVESTIGATION OF THE DEHYDROGENATION OF ETHYLENE WITH THE AID OF DEUTERATED COMPOUNDS. Yampol'skii, Yu. P. (Inst. of Petrochemical Synthesis, Moscow). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 23: No. 3, 532-537(Mar 1974).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 23: No. 3, 564-570(Mar 1974).

Investigation of the thermal conversions of mixtures of C_2H_4 + C_2D_4 at 750-1000° showed that at temperatures above 850°, the predominant process of formation of H_2 in the pyrolysis of C_2H_2 is the reaction of atomic hydrogen with ethylene. The rate constant of this reaction was measured in the interval 820-940°, and the Arrhenius dependence was found. (auth)

2907 DETERMINATION OF THE RATE CONSTANT OF THE REACTION $H + C_2D_4 \rightarrow C_2D_3H + D$. Yampol'skii, Yu. P. (Inst. of Petrochemical Synthesis, Moscow). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 23: No. 3, 538-540(Mar 1974).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 23: No. 3, 570-573.

The mechanism of isotopic exchange of C_2D_4 in the pyrolysis of C_2H_6, C_2H_4, and C_2H_2 was studied, and the rate constant of the reaction $H + C_2D_4 \rightarrow C_2D_3H + D$ was determined at the temperatures 1000-1200°K. (auth)

2908 RATES OF ISOTOPIC EXCHANGE BETWEEN HYDROGEN AND AMINOMETHANE CATALYZED BY POTASSIUM METHYLAMIDE. Kalra, H.; Otto, F. D. (Univ. of Alberta, Edmonton). Can. J. Chem.; 52: No. 2, 258-262(Apr 1974).

Pseudo first-order kinetic constants for the exchange of deuterium between hydrogen and aminomethane were determined from measurements of the rates of absorption of hydrogen deuteride into liquid aminomethane flowing over a sphere. Potassium methylamide dissolved in the amine catalyzed the reaction. Kinetic constants range from 130 to 650 sec^{-1} at temperatures from –30 to –10°C and catalyst concentrations of 4.95 to 15.8 g K/kg amine. (auth)

2909 SYNTHESIS AND APPLICATION OF ANCHORED CATALYSTS IN HYDROGEN ISOTOPE EXCHANGE SYSTEMS. D_2-Protic Solvent Exchange. Strathdee, G.; Given, R. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Can. J. Chem.; 52: No. 17, 3000-3007(1 Sep 1974).

A number of polymer-attached, or anchored, catalysts of rhodium and ruthenium have been synthesized, and their activities for D_2 exchange with ethanol have been measured. Among the rhodium-anchored catalysts, three exhibited specific activity comparable to Wilkinson's catalyst, $RhCl(PPh_3)_3$. No polymer-attached ruthenium species had specific activities close to that of the active homogeneous catalyst $RuCl_2(PPh_3)_3$. Conditions for the synthesis and optimum loading of complexing resins are discussed. Structural and kinetic comparisons are made between anchored catalysts and their homogeneous analogs. (auth)

2910 HYDROGEN–DEUTERIUM EXCHANGE IN THE GENETIC VARIANTS A, B, AND C OF BOVINE β-LACTOGLOBULIN. Ralston, G. B. (Univ. of Wisconsin, Madison). Aust. J. Chem.; 27: No. 5, 473-477(Oct 1974).

The hydrogen–deuterium exchange in the β-lactoglobulin genetic variants A, B, and C was studied by using an infrared spectrophotometric technique. Between pD 3.1 and 7.6 the exchange behavior of all three proteins was identical, within the limits of experimental accuracy. Conformation transitions that result in changes in specific optical rotation between pH 4 and 6 for each of the proteins could not be detected by means of the hydrogen exchange measurements, suggesting that this particular conformation change is either very small in terms of the numbers of peptide groups involved, or is limited to rapidly exchanging surface groups. In the pD range studied the exchange of all three proteins was consistent with the EX mechanism. (auth)

Feed Materials Processing

Refer also to abstract 5372.

2911 (AAEC/E-284) THERMAL DENITRATION OF URANYL NITRATE IN A FLUIDIZED BED REACTOR. Fane, A. G.; Charlton, B. G.; Alfredson, P. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jul 1974. 43p. Dep. NTIS (US Sales Only) $5.25.

Commissioning and operating experience are described for the thermal denitration of uranyl nitrate in a 0.1-m-diam fluidized bed reactor. The effects of operating temperature, uranyl nitrate concentration and feed rate, nozzle air to liquid flow ratio, and the addition of sulfate to the feed, on the characteristics of the product and equipment performance were examined. Particle growth was a predominant feature which was strongly influenced by operating temperature. Changes in the main process variables exerted a minor influence on other properties of the product. The addition of sulfate to the uranyl nitrate feed solution produced an increase in surface area, and a decrease in pour and tap density. The wall-to-bed heat transfer coefficient was in the range 190 to 265 W $m^{-2}K^{-1}$, and shown to be an inverse function of the average particle size. (auth)

2912 (CEA-CONF-2643) PRODUCTION AND TRANSFORMATION OF URANIUM IN FRANCE. Gangloff, A.; Granjon, D.; Maget, P. (CEA Direction des Productions, 92–Chatillon (France); Compagnie Francaise des Minerais d'Uranium, 75–Paris (France)). 1973. 21p. (In French). (CONF-730983-24). Dep. NTIS (US Sales Only) $4.25.

From congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France (11 Sep 1973).

The production is delivered in the form of a nuclearly pure end product to fabricators of natural uranium nuclear fuel or to enrichment plants. It is the first link in the nuclear fuel cycle and itself consists of three activities, exploration for uranium-bearing ores, mining and concentrate production, and transformation of uranium. Each of these activities has specific features in common with certain more general industries, respectively mining and oil prospection, mine operation proper and the chemical industry. Each activity is described briefly, and the results and achievements of the French industry are discussed. The world setting at present is unfavorable, by reason of excess stocks and capacity. However, the medium-term outlook is satisfactory, in view of the foreseen upsurge of demand starting from the end of this decade. (FR)

2913 (PB-230181) OPTIMIZATION OF SOLUBLE URANIUM RECOVERY IN ROTARY VACUUM FILTRATION OF ACID-LEACHED GOLD ORE SLURRY. Verbaan, B.; McEvoy, M. A. J. (Council for Scientific and Industrial Research, Pretoria (South Africa)). May 1973. 46p. (SIR-SR-CENG-010). NTIS $5.50.

The performance of a pilot rotary vacuum filter was shown to correlate with that of full scale equipment. Recovery of 97% of the soluble uranium was obtained in a single filtration stage (pilot filter) using feed pulp diluted to density 1440 KG/CU M and uranium-free wash; a corresponding 24% reduction in solids throughput was observed. Other results indicate that 98% recovery can be obtained by further dilution and the duty improved through an increased addition of flocculant. Single stage filtration should be tested with a full scale filter under the conditions recommended. Optimization strategies are outlined to suit various operating requirements. (GRA)

2914 (PB-230187) EFFECT OF FLOOD WASHING OF SOLUBLE URANIUM ON ROTARY VACUUM FILTERS. Verbaan, B. (Council for Scientific and Industrial Research, Pretoria (South Africa)). May 1973. 30p. (CSIR-SR-CENG-009). NTIS $4.50.

The effect of a supernatant layer of wash liquor in the pan on the soluble uranium recovery and the solids filter duty was investigated and the results are discussed. (GRA)

2915 ELDORADO NUCLEAR LIMITED, ANNUAL REPORT, 1973. Ottawa; Eldorado Nuclear Ltd. (1973). 16p.

The annual report for Eldorado Nuclear Limited is presented for the year ended December 31, 1973. For the fifth consecutive year the production of U_3O_8 from the Beaverlodge and Hab mines was curtailed and it appears such controls will have to be continued until demand matches supply capability. At the Port Hope Refinery ceramic grade UO_2 production was at a peak, reflecting the needs of Ontario Hydro for CANDU fuel. Several major sales of uranium metal castings were made. (ECB)

2916 UCAN 1972 ANNUAL REPORT, Dec. 1973. Ottawa; Uranium Canada, Ltd. (1973). 15p. (In English and French).

During 1972 Uranium Canada, in collaboration with the Government of Canada and Denison Mines Ltd., concluded contracts for the sale of some nine million pounds of uranium concentrates to nine companies operating seven nuclear reactors in Spain. In addition, Japan has contracted for some two million pounds of concentrates. The Company is attempting to coordinate supply with demand in the uranium industry and is charged to act as an agent on behalf of the federal government with respect to the acquisition and future sales of two uranium concentrate stockpiles. (ECB)

2917 DEVELOPMENTS IN URANIUM ORE PROCESSING. Lendrum, F. C. CIM (Can. Mining Met.) Bull.; 67: No. 749, 51-54 (Sep 1974).

With the resurgence of interest in uranium, there was a need for a review of the state-of-the-art in milling uranium ores. This paper reviews the current processes and discusses proposed processes for the production of "yellow-Cake" from uranium ores. (auth)

Radiation Chemistry

Refer also to abstracts 2875, 3006, 3053, 3580, 3622, and 3646.

2918 (AD-781162) GAS LIBERATION DURING LEAD AZIDE RADIOLYSIS. Ryabykh, S. M.; Zakharov, Yu. A. Translated from Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Teknol.; 13: No. 12, 1737-1739(1970). 6p. NTIS $4.00.

Gas evolution of lead azide upon irradiation with an absorbed dose of 4.3×10^{16} eV/g. sec in the 0-100°C range at a residual pressure of 0.0001 mm Hg was studied. It was found that the gas evolution rate during irradiation is directly proportional to the surface area of the irradiated substance. (GRA)

2919 (COO-1763-41) STRUCTURE IN THE OPTICAL ABSORPTION SPECTRUM OF THE SOLVATED ELECTRON? Gavlas, J. F.; Dorfman, L. M. (Ohio State Univ., Columbus (USA). Dept. of Chemistry). 1974. Contract AT(11-1)-1763. 12p. Dep. NTIS $4.00.

The optical absorption spectrum of the solvated electron in ethanol was determined again to establish whether a report of observed structural features by Vannikov and Marevtsev, which appears to be discordant with earlier data, can be sustained. Our data do not reveal such structural features, and are furthermore in significant disagreement with the general contour of the absorption band reported by these authors. (auth)

2920 (COO-1763-42) OPTICAL ABSORPTION SPECTRUM OF THE SOLVATED ELECTRON IN SOME LIQUID AMIDES AND AMINES. Gavlas, J. F.; Jou, F. Y.; Dorfman, L. M. (Ohio State Univ., Columbus (USA). Dept. of Chemistry). 1974. Contract AT(11-1)-1763. 19p. Dep. NTIS $4.00.

The optical absorption spectrum of the solvated electron was determined, at room temperature, in several amides and amines. The absorption maxima were found to be: N,N-dimethylformamide, 1680 nm; N,N-dimethylacetamide, 1800 nm; N,N-diethylformamide, 1775 nm; dimethylamine, 1950 nm; 1,2-propanediamine, 1500 nm. The results for these amides are not in accord with an empirical correlation of such data recently proposed by Freeman. The general spectral grouping of the absorption of e_s^- in a variety of liquids with type of compound is discussed. Rate constants were determined for reactions of e_s^- in ethanol with formamide, N-methylformamide, and N,N-dimethylformamide. The values are respectively 1.8×10^6 M^{-1} sec^{-1}, 2.2×10^8 M^{-1} sec^{-1}, and 1.1×10^9 M^{-1} sec^{-1}. (auth)

2921 (COO-1763-43) OPTICAL ABSORPTION SPECTRUM OF THE SOLVATED ELECTRON IN POLAR LIQUIDS AND IN BINARY SOLUTIONS. Dorfman, L. M.; Gavlas, J. F. (Ohio State Univ., Columbus (USA). Dept. of Chemistry). 1974. Contract AT(11-1)-1763. 21p. Dep. NTIS $4.25.

Optical absorption spectra are now known for a considerable variety of compounds ranging from strongly polar to weakly polar liquids in which the absorption maximum may fall in the region 500 nm to 2300 nm. Some new results for amides and amines are presented and considered along with the data for alcohols, ethers, water and other compounds with regard to the dependence of λ_{max} upon type of compound. Data for binary solutions are discussed. Correlations with one empirical relationship and with two theoretical models are mentioned. With regard to structure in the room temperature spectrum of e_{sol}^- recent measurements do not sustain reports, that structure may be resolved in the spectrum in ethanol. (auth)

2922 (COO-1763-44) IONIC AGGREGATION OF THE SOLVATED ELECTRON WITH LITHIUM CATION IN TETRAHYDROFURAN SOLUTION. Bockrath, B.; Dorfman, L. M. (Ohio State Univ., Columbus (USA). Dept. of Chemistry). 1974. Contract AT(11-1)-1763. 25p. Dep. NTIS $4.50.

Aggregation of the solvated electron with lithium cation in tetrahydrofuran forms ionic species investigated by the pulse radiolysis method. The ion pair (Li^+, e_s^-) has a near infrared absorption band with $\lambda_{max} = 1175$ nm and a molar extinction coefficient of 2.28×10^4 M^{-1} cm^{-1} at the maximum. A higher aggregate, suggested to be the dilithium cation–electron triple ion, $\{(Li^+)_2e_s^-\}$ has an optical absorption band with $\lambda_{max} = 890$ nm and an extinction coefficient of 5400 M^{-1} cm^{-1} at the maximum. Absolute rate constants have been determined for reactions of these species with anthracene, biphenyl, and dibenzylmercury. The reactivities of these two species are compared along with the reactivities of (Na^+, e_s^-) and e_s^- in THF solution. (auth)

2923 (COO-1763-45) PROTONATION RATE CONSTANTS AND OPTICAL ABSORPTION SPECTRA OF BENZYL CARBANION PAIRS IN TETRAHYDROFURAN SOLUTION. Bockrath, B.; Dorfman, L. M. (Ohio State Univ., Columbus (USA). Dept. of Chemistry). 1974. Contract AT(11-1)-1763. 18p. Dep. NTIS $4.00.

The benzyl carbanion paired with lithium cation and with tetrabutylammonium ion was formed in tetrahydrofuran solution and investigated by the pulse radiolysis method. Absolute rate constants for the protonation of both of these species by methanol and by t-butanol were determined. These data, and previous data for benzyl sodium, show that the ion paired species is more reactive, in these protonations, than is the free carbanion. The optical absorption spectra of both $PhCH_2^-Li^+$ and $PhCH_2^-NBu_4^+$ were determined. The latter exhibits a band maximum at 342 nm, the former, in agreement with data from equilibrium studies, at 330 nm. The effect of ion pairing upon the absorption spectrum of $PhCH_2^-$ by Li^+, Na^+ and NBu_4^+ is shown. (auth)

2924 (HASL-287, pp 97-99) TECHNIQUES OF ENVIRONMENTAL RADON MEASUREMENT. Breslin, A. J. (USAEC Health and Safety Lab., New York). Sep 1974.

From 2nd environmental radiation workshop; New York, New York, USA (20 Feb 1974).

In second workshop on the natural radiation environment (February 1974).

Methods are being developed for the measurement of radon emanation from the ground, basement floors, and structural surfaces. The techniques, consisting of both grab-sampling methods and automatic, integrating instruments, comprise a flexible investigative capability. Intercalibration of measurement techniques has been initiated with other groups having similar interests in ambient radon studies. (MCG)

2925 (KFKI-74-54) RADIATION CHEMICAL YIELD AND MOBILITY OF ELECTRONS IN LIQUID HYDROCARBONS. Schiller, R.; Vass, S. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 16p. Dep. NTIS (US Sales Only) $4.00.

Geminate ion-electron recombination is being reconsidered theoretically and compared with the experimentally observed interdependence between free ion yield, G_{fi} and electron mobility, μ or quasi-free electron energy, V_0. Thermal electrons are regarded as being formed in the quasi-free state, hence their motion can be described as that of a spherical wave with the geminate positive ion in the center. Using a particle-in-a-box model one can show that the escape probability of thermal quasi-free electrons equals $\frac{1}{2}$ in each and any system. Further it is assumed that the escaped fraction of quasi-free electrons partially localize in the liquid. In this second stage of their life localized electrons behave as do heavy particles in that they obey Onsager's recombination law. The distribution of distances between ions and localized electrons, an essential function in the Onsager theory, can be expressed in terms of trapping probability which is a function of either V_0 or μ. Calculated $G_{fi}/V_0/$ and $G_{fi}/\mu/$ curves adequately agree with experiment. (auth)

2926 (ORO-2968-90) RESEARCH CONCERNING IONIC AND FREE RADICAL REACTIONS IN RADIATION CHEMISTRY. Progress Report, September 15, 1973–September 15, 1974. Williams, T. F. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1974. Contract AT(40-1)-2968. 89p. Dep. NTIS $7.50.

Progress in the following research projects is reported: angular dependence of proton hyperfine splittings in the ESR spectrum of the methylsulfinyl radical; ESR spectra of OSeCl, OSCl, and OSBr; ESR and structure of $SO_2CL_2^-$; electronic structure of phosphoranyl radicals; ESR identification of the dimer radical cation $[(CH_3O)_3P-P(OCH_3)_3]^+$ in γ-irradiated trimethyl phosphite from second-order hyperfine structure; structure and reactivity of methyl radical–cyanide ion pairs in crystal I and crystal II of acetonitrile; and methyl radical–methanesulfonate anion pairs formed by dissociative electron capture in γ-irradiated crystalline dimethyl sulfoxide-d_6 at 77°K. (LK)

2927 (ORO-3781-11) INVESTIGATION OF GAMMA-RAY INDUCED POLYMER FORMATION OF THE CARBORANES. Annual Progress Report, November 1, 1973–October 31, 1974. Klingen, T. J. (Mississippi Univ., University (USA). Dept. of Chemistry). 1 Nov 1974. Contract AT(40-1)-3781. 66p. Dep. NTIS $6.50.

Results obtained during the year on the radiation chemistry of o-carborane and its alkyl and alkenyl derivatives are reported. Completion of studies on the EPR of γ-irradiated solid carboranes at 77°K and alkane glass solutions and on the radiolysis of 1-allyl-o-carborane was reported in the published literature. Results obtained in continuing studies of the γ-induced co-polymerization of 1-vinyl-o-carborane with polyethylene and of the radiolysis of o-carborane under electrons and ^{60}Co γ radiation were reported. Preliminary results indicate that in the copolymerization crosslinking of the polyethylene chains by the 1-vinyl-o-carborane occurs as a result of radiolysis. The preliminary results on the direct radiolysis of o-carborane cage lead to measurable yields of the products and to the fact that the cage is not radiolytically inert as had been supposed. (JSR)

2928 (ORO-4183-17) CHEMICAL EFFECTS OF IONIZING RADIATIONS ON THE INDIVIDUAL AMINO ACIDS WITHIN INTACT AND PURE PROTEIN MOLECULES. Annual Progress Report for the Period Beginning February 1, 1974. Friedberg, F. (Howard Univ., Washington, D. C. (USA). Dept. of Biochemistry). 30 Oct 1974. 20p. Dep. NTIS $4.00.

The effects of certain metal ions (Cu^{2+}, Fe^{2+}, Ni^{2+}, and Cd^{2+}) on the γ-radiolysis of collagen and of polyadenylic acid in the solid state were investigated in the absence of air. A considerable degree of similarity was found between the effects of metal ions in decreasing the radioinduced decrease of the weight average molecular weight (as measured by the sedimentation equilibrium method) and the formation of stable carbon radicals at room temperature, which was followed by electron spin resonance measurements. (auth)

2929 (RRL-3238-496) ANNUAL REPORT, OCTOBER 1, 1973–SEPTEMBER 30, 1974. (Mellon Inst., Pittsburgh, Pa. (USA). Radiation Research Labs.). 8 Oct 1974. 31p. Dep. NTIS $4.75.

A very brief general summary of the research activities at Mellon Institute is given. The in-situ radiolysis–ESR methods were used for most of the investigations. A list of the publications and oral presentations made during the October 1, 1973 through September 30, 1974 period is included. (LK)

2930 (TID-26640) INDEX AND CUMULATIVE LIST OF PAPERS ON RADIATION CHEMISTRY. Vol. VI, Nos. 1-26, January–June 1973. (Notre Dame Univ., Ind. (USA). Radiation Lab.). Jul 1973. 410p. Dep. NTIS $23.50.

Papers on radiation chemistry published from 1971 to 1973 are compiled together with an author index and keyword index. The papers are categorized into radiation chemistry, polymers, biological systems, hot atom chemistry, esr, luminescence, photochemistry, theoretical, and miscellaneous. The references were obtained from scanning about 50 current journals and from computer searches of Chemical Abstracts Condensates and Nuclear Science Abstracts tapes. (JSR)

2931 ELECTRON SPIN RESONANCE STUDIES ON GRAFT COPOLYMERIZATION OF GASEOUS STYRENE ONTO PREIRRADIATED POLYPROPYLENE. II. Preirradiation under Vacuum. Nunome, K.; Eda, B.; Iwasaki, M. (Government Industrial Research Inst., Nagoya, Japan). J. Appl. Polym. Sci.; 18: No. 9, 2711-2717(Sep 1974).

Graft copolymerization of gaseous styrene was carried out at 40°C onto polypropylene preirradiated under vacuum. In order to investigate the origin of graft initiation activity, ESR spectra of irradiated polymers were measured and discussed. Although there are about three times as many radicals trapped in the same irradiated at −78°C as in the sample irradiated at room temperature, both the samples showed nearly same degree of grafting. This is due to the ineffectiveness of radicals trapped in the amorphous region for grafting. The samples irradiated under vacuum showed more grafting than those irradiated in an oxygen atmosphere. This is compatible with the conclusion in the previous paper that in grafting of polypropylene irradiated in an oxygen atmosphere the carbon radicals produced by hydrogen abstraction by trapped peroxy radicals are the effective active centers. (auth)

2932 RADIOLYSIS IN THE GASEOUS PHASE OF HYDROCARBONS. Caldararu, M.; Bica, I. (Centrul de Chimie Fizica, Bucharest). Stud. Cercet. Chim.; 22: No. 4, 419-441(Apr 1974). (In Rumanian).

The principal processes occurring in the gaseous phase radiolysis of simple alkanes and alkenes were discussed in detail. The radiolysis products formed are explained by the separate or simultaneous contribution of the destruction of the molecule and the radical reactions of fragmented molecules or excited ions. (tr-auth)

2933 IONIZING RADIATION-INDUCED CHANGES IN CHLORINATED HYDROCARBONS. Ceurvels, A. R. (Massachusetts Div. of Marine Fisheries, Salem); DerHovanesian, J. Jr.; Kaylor, J. Mar. Pollut. Bull.; 5: No. 9, 143-144(Sep 1974).

A pilot study was undertaken to explore the effects of ionizing radiation on chlorinated hydrocarbon pesticides to determine whether more biodegradable products could conveniently be formed to facilitate their disposal in discharges from manufacturing processes. Five pesticides, aldrin, dieldrin, heptachlor, lindane and DDT were irradiated with 0.5 to 2.5 megarads γ radiation and 10 to 20 megarads β radiation. Gas chromatographs were obtained before and after irradiation. There was no detectable change after 20 megarads exposure to β radiation but in the case of heptachlor after γ irradiation at least three breakdown products were observable. If these products represent less chlorinated derivatives of heptachlor they are probably more readily biodegradable. The results confirm that high level γ radiation induces degradation of chlorinated hydrocarbon pesticides. (UK)

2934 RADIOLYSIS OF BIOCHEMICAL SYSTEMS USING ADAMANTANE AS AN ISOLATION MATRIX. Manzuk, M. E.; Winters, D. L.; Hyfantis, G. J.; Ling, A. C. (Univ. of West Virginia, Morgantown). Int. J. Radiat. Biol.; 26: No. 1, 51-64(Jul 1974).

The use of adamantane matrices for investigating radiolysis processes in biochemically relevant systems is described. Data are given for radiolyses of D-(−)-ribose, D-2-deoxyribose, thymine, and cytosine, and possible radicals formed are discussed. Experimental details and data are given for radiolyses conducted in vacuo, under various gaseous atmospheres (CO, CO_2, O_2, air, N_2O, and SO_2), and for samples irradiated in vacuo and then exposed to various atmospheres to investigate the possible binding of small molecules to radical sites. (auth)

2935 SELECTIVE FREE RADICAL REACTIONS WITH PROTEINS AND ENZYMES: The Inactivation of α-Chymotrypsin. Baverstock, K.; Cundall, R. B.; Adams, G. E.; Redpath, J. L. (Univ. of Nottingham, Eng.). Int. J. Radiat. Biol.; 26: No. 1, 39-46(Jul 1974).

The reactions of the selective free radicals $(CNS)_2^-$ and Br_2^- with α-chymotrypsin were studied by pulse radiolysis and steady-state inactivation measurements. Rate-constants for the reaction were measured over the pH range 7 to 12. The reactivity increases at pH 11 where the tyrosine residues deprotonate. Transient product spectra also indicate a significant increase in attack at tyrosine at this pH. A small increase in rate was observed by lowering the salt concentration from $10^{-1}M$ to $4 \times 10^{-2}M$. The inactivation data show $(CNS)_2$ to be protective relative to OH over the pH range 2 to 11, whereas Br_2^- sensitizes between the pH range 4 and 9. From the pulse radiolysis and inactivation data, it was concluded that a histidine residue was essential to the activity of α-chymotrypsin. (auth)

2936 ELECTRON SPIN RESONANCE STUDIES ON GRAFT COPOLYMERIZATION OF GASEOUS STYRENE ONTO PREIRRADIATED POLYPROPYLENE. III. Preirradiation Under Vacuum Followed by Exposure to Oxygen at −78°C. Nunome, K.; Eda, B.; Iwasaki, M. (Government Industrial Research Inst., Nagoya, Japan). J. Appl. Polym. Sci.; 18: No. 9, 2719-2723(Sep 1974).

Grafting of styrene vapor was carried out onto polypropylene γ-irradiated under vacuum followed by exposure to oxygen at −78°C. A comparison with the results on polypropylene irradiated in an oxygen atmosphere leads to an interesting result. Two samples were irradiated at room temperature under vacuum and in an oxygen atmosphere, respectively, the former being followed by exposure to oxygen. Although irradiation was carried out at room temperature for either sample and nearly the same amounts of the peroxy radicals are trapped, the former showed more grafting than the latter. The origin of this difference was investigated by means of electron spin resonance. Significant differences were observed in ESR spectra as well as in isothermal decays of the trapped peroxy radicals. In the former sample, the trapped peroxy radicals had a higher mobility, and consequently a significant hydrogen abstraction by the peroxy radicals was observed during storage at 40°C. This result supports the conclusion of the previous paper that the radicals effective in the grafting reaction of polypropylene preirradiated in an oxygen atmosphere are the carbon radicals which are produced by hydrogen abstraction by the peroxy radicals. (auth)

2937 ELECTRON SPIN RESONANCE STUDY ON FREE RADICALS IN METHYLAZOXYMETHANOL BENZOATE, AGLYCONE DERIVATIVE OF CYCASIN INDUCED BY X IRRADIATION. Morita, N. (Kagoshima Univ., Japan); Hayashi, T.; Yunoki, K.; Kawano, I. Kagoshima Daigaku Igaku Zasshi; 25: No. 3, 245-247 (Dec 1973). (In Japanese).

As a process in the examination of the relationship between the chemical reactivity of methylazoxymethanol benzoate (MAM-B), an aglycon derivative of cycasin possessing carcinogenicity and carcinogenicity radicals produced by x-ray irradiation were examined by electron spin resonance (ESR). With 30 KV, 10 mA, and a copper target, continual x-ray irradiation for 12−24 hours was performed. Measurements were made at room temperature by x-ray band using JES-ME-3X type ESR apparatus manufactured by Nihon Denshi. The ESR measurement conditions: the sweep range of the magnetic field −3000 ± 1000 Gauss changed according to purpose, 3240 ± 5°G, gain −10 × 100, 2 × 100, 7.9 × 100, and 12.5 × 100, resonance−10 sec and 7.13 sec, modulation width −10G for the detection of signal. As a result, although the MAM-B itself did not possess radicals, when MAM-B was irradiated by x-rays, ESR signal was obtained by the sweep range of the magnetic field of 3000 ± 1000 G, 2 × 100 gain, 10 sec resonance, and 10G modulation width. From the absorption curve obtained by changing the magnetic field to 3270 ± 10G and gain to 7.9 × 100 and overlapping 1G of modulation width, it was confirmed that radicals were produced in MAM-B by x-ray irradiation. The produced radicals were stable for more than several weeks. No radical was observed in MAM-B itself when no irradiation was performed. (JA)

2938 INITIAL RADIOLYTIC REACTIONS IN AQUEOUS SOLUTIONS AT PICOSECOND TIMES. Wolff, R. K. Toronto; Univ. of Toronto (1972). vp. National Library of Canada, Ottawa.

Thesis (Ph.D.).

The stroboscopic pulse radiolysis system was used to study initial radiolytic reactions in aqueous solutions. Studies of the solvated electron, e^-_{aq}, and the hydroxyl radical, OH, and their precursors were conducted at early times (30−350 psec) and in high concentrations of solute (0.1−5.0 M). The fast time response of 24 psec is a unique feature of our system which allows us to probe deeply into initial molecular events. The initial yield of the solvated electron in pure H_2O and its early kinetics were determined. The initial yield was found to be 4.0 ± 0.2 molecules per 100 eV energy absorbed in the solution. It was also found that there was no decay (±5%) over the initial 30−350 psec time interval following irradiation. These facts have been a subject of great experimental controversy because of the difficulty of making accurate measurements. These observations were also of fundamental importance regarding theories in radiation chemistry as they must conform to these basic facts. (LK)

2939 EFFECTS OF A STERILIZING DOSE OF RADIATION ON THE PROPERTIES OF POLYMERS USED IN MEDICINE. Postrigan, M. V.; Krivonosov, A. I.; Tikhomirova, N. S.; Apinis, A. P.; Kayin'n, F.; Raykhlin, L. B. Plast. Massy; No. 2, 24-26 (1974). (In Russian).

The effects of small doses of gamma radiation on polymeric materials used to construct blood transfusion systems were studied. Standard samples of polyethylene (PE), poly(vinyl chloride)-plasticized resin (PVC) and poly(methyl methacrylate) (PMM) were subjected to doses from 1.5 to 10 Mrad at a rate of 1 Mrad/hr. Differential thermal analysis of PE showed that the melting point of irradiated samples was about 5° higher than nonirradiated, probably due to crosslinking. Irradiation up to 5 Mrad also raised the second transition temperature of high density PE by 12°, which can be due to branching, and caused a small increase in stretching stability and breakage elongation. Experimental samples of PE were oxidized more rapidly than controls. While stability was unchanged during 1 year of storage, relative breakage elongation decreased more from irradiated polymers. When low density PE was irradiated with 20 Mrad its stretching stability was marked increased and its vapor permeability lowered. For PMM the molecular weight was found to decrease on gamma treatment, as well as the glass transition temperature and stability to thermal oxidation, while changes in physical-mechanical properties were not affected. Most properties of PVC were not changed on irradiation, though transparency decreased from 85 to 75% and breakage elongation after storage was somewhat decreased. All the above changes are quite small so these materials can be recommended for radiation sterilized medical use. (JPRS)

2940 EPR STUDIES: I. γ-IRRADIATED SUCCINIC ACID SINGLE CRYSTALS. II. FLUORINATED BENZENE ANION RADICALS. III. FLUORINATED CYCLOHEXADIENYL RADICALS. Yim, M. B. Storrs, CT; Univ. of Connecticut (1974). 122p. University Microfilms Order No. 74-21,814.

Thesis (Ph. D.).

Part I. Several structures were proposed for the single-line radical produced in γ-irradiated single crystals of succinic acid at room temperature. This work is an attempt to clarify the structure of this radical. The g tensor and α and β ^{13}C hyperfine splitting (hfs) tensors of the radical were obtained from succinic acid-d_6 with ^{13}C in natural abundance. The isotropic ^{13}C hfs constants of 131.8 and 47.7 G for α and β carbons, respectively, are unusually large compared to the usual π radicals. The direction cosines of the principal values of the g and hfs tensors indicate that the structure of this radical is $HOOCCH_2CH_2C = O$. Spin density calculations show that the majority of the unpaired electron density, ~60%, is located in the σ orbital arising from the rupture of the C−OH bond in the undamaged molecule. A possible mechanism for spin distribution in this radical is discussed.

Part II. Hexafluorobenzene, pentafluorobenzene, and tetrafluorobenzene anion radicals were prepared by x-irradiation at 77°K of an adamantane matrix doped with the parent benzene and trimethylamine-borane (TMAB). Benzene and hexafluorobenzene anion radicals were also prepared by photolysis of the neutral precursors in a sodium-adamantane matrix. The fluorinated anions show very large fluorine hfs constants which are not typical of π radicals. Furthermore, comparison of the fluorine hfs constants of the anion radicals with those of their cation radicals indicates that the orbital pairing rule is violated. This suggests that the fluorinated anions have a considerably different electronic structure than the cations. INDO calculations show that the lowest unoccupied σ^* orbital moves lower with respect to the lowest unoccupied π^* orbital in the benzene molecule as more hydrogen is replaced by fluorine. The spectral patterns of the pentafluorobenzene and 1,2,4,5-tetrafluorobenzene anion radicals cannot be described by the INDO hfs constants calculated for π states while they can for the σ state calculations. The clear implication is that the anion radicals obtained here are σ radicals and that σ^*-π^* crossing-over has occurred between benzene and tetrafluorobenzene.

Part III. Cyclohexadienyl radical and six fluorinated cyclohexadienyl radicals were prepared by x-irradiation of adamantane matrices doped with: benzene, monofluoro-, 1,4-difluoro-,1,3,5-trifluoro-, 1,2,4,5-tetrafluoro-, pentafluoro-, and hexafluorobenzene. The EPR spectra obtained were analyzed and simulated by computer. The substitutions of fluorine in the ring did not greatly affect the remaining hydrogen hfs constants in the ring but there was a large effect on the methylene hydrogen hfs constants. These results were satisfactorily explained in terms of the effect of fluorine on hyperconjugation. INDO energy minimization to obtain the optimum geometry for cyclohexadienyl radical results in a distorted planar hexagon and gives the experimentally observed trend of the hfs constants. The major experimental hfs trends upon fluorine substitution were also correctly predicted by INDO. (Diss. Abstr. Int., B)

2941 ESR STUDY OF IRRADIATED PENTACYANONITROSYL COBALTATE II. Manoharan, P. T. (Indian Inst. of Tech., Madras); Subramanian, S.; Rogers, M. T. J. Coord. Chem.; 3: No. 4, 293-299(May 1974).

An ESR study of γ-irradiated pentacyanonitrosyl cobaltate (II) shows the presence of two paramagnetic species. One, with $g_{||} = 2.005$, $g_{\perp} = 2.172$, $A_{||} = 81.3$, and $A_{\perp} = -26.2 \times 10^{-4}$ cm^{-1}, is the well-known d^7 species $Co(CN)_5^{3-}$. The second shows $g_{||} > g_{\perp}$ and much lower ^{59}Co hyperfine interactions. The ESR parameters are shown to be consistent with those predicted for the species $[Co(CN)_5NO]^{4-}$ with C_s symmetry, a bent Co–N–O bond, and a d_7 configuration with the odd electron in an a′ orbital formed by mixing the cobalt $d_{x^2-y^2}$ and d_{z^2} orbitals. Theoretical arguments are advanced to show that, in general, small metal hyperfine splittings in low symmetry ions do not necessarily establish that the unpaired electron is in a ligand-dominated orbital. (auth)

2942 OXIDATION OF HYDROXYCYCLOHEXADIENYL RADICAL BY METAL IONS. Bhatia, K.; Schuler, R. H. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 78: No. 23, 2335-2338(7 Nov 1974).

The radiation chemical yield for the production of phenol in the radiolysis of N_2O saturated aqueous solutions of benzene containing 10^{-4} to 10^{-3} M ferricyanide was found to be 6.0. This result implies that the hydroxycyclohexadienyl radical produced by the addition of OH to benzene is quantitatively oxidized to phenol by the ferricyanide and that there is negligible interference from side reactions including those resulting from the buildup of ferrocyanide. Other metal oxidants examined (Cu^{2+}, Ag^+, Fe^{3+}, Cr^{3+}) gave lower radiation chemical yields and complications are apparent. For 10^{-4} to 10^{-3} M cupric ion the initial yields appears to be ~6 but the actual yields observed at doses $>10^{17}$ eV/g are lower and markedly dependent on the cupric concentration. The pronounced curvature in the phenol production curves which occurs when >10% of the Cu^{2+} ion has reacted can be explained if the hydroxycyclohexadienyl radical is reduced by cuprous ion ~5 times more rapidly than it is oxidized by cupric. Permanganate interferes by oxidizing the phenol produced further and silver ion does not effectively compete with the other radical termination processes. Hydroxylation of bromobenzene in the presence of ferricyanide accounts for a yield of only 3.9. Bromide produced by OH attack at the Br position accounts for an additional yield of 0.8 for a total yield of 4.7. In this case the oxidation of the intermediate hydroxycyclohexadienyl radicals by the ferricyanide is somewhat less than quantitative. (auth)

2943 HYDROPEROXYL RADICAL REACTIONS. III. Pulse-Radiolytic Study of the Reaction of the Hydroperoxyl Radical With Some Metal Ions. Meisel, D.; Ilan, Y. A.; Czapski, G. (Hebrew Univ., Jerusalem). Contract AT(11-1)-3221. J. Phys. Chem.; 78: No. 23, 2330-2334(7 Nov 1974).

The reactions of HO_2 with U(VI), Th(IV), and Ce(III) were studied by the pulse radiolysis technique. Optical spectra of the U(VI) and Th(IV) complexes with HO_2 were obtained as well as the rate of their formation and decay. Evidence is presented that Ce(III) is oxidized by HO_2 radicals to give Ce(IV), and this rate was measured. (auth)

2944 ESR STUDY ON FREE RADICALS IN N-METHYL-N′-NITRO-N-NITROSOGUANIDINE INDUCED BY × IRRADIATION. Morita, N. (Kagoshima Univ., Japan); Yunoki, K.; Kawano, I. Kagoshima Daigaku Igaku Zasshi; 25: No. 3, 253-255(Dec 1973). (In Japanese).

As an approach to the elucidation of the carcinogenic mechanism of N-methyl-N′-nitro-N-nitrosoguanidine (MNNG), measurements of radicals induced by x-ray irradiation were performed by means of electron spin resonance (ESR). The above mentioned compound was irradiated with x rays (30KV, 10mA, copper target) at room temperature continually for 12 to 24 hours for measurements at room temperature by x-band using JES-ME-3X type ESR apparatus manufactured by Nihon Denshi. The ESR measurement conditions were the sweep range of the magnetic field of 3250 ± 100 gauss, gain 5 × 100, response 10 sec., modulation width 2G, and power 10 m W. They produced an absorption curve over the range of about 120 gauss. At 2 gauss, a hyperfine structure indication of the presence of a free radical was observed. This radical was stable over several weeks. MNNG itself has no radical without x irradiation. (JA)

2945 EFFECT OF RADIATION ON ELECTROPHYSICAL PROPERTIES OF THE EPOXY COMPOUND EXK-10. Kessenikh, R. M.; Petrov, A. V.; Shumilov, Yu. N.; Korshunova, L. A. Plast. Massy; No. 6, 17-18(1974). (In Russian).

Experimental results are described of the effect of electron radiation on heat expansion, dielectric losses, and electric resistance of the epoxy compound EXK-10 made from the resin EDL. It was established that the compound EZK-10 is radiation stable when subjected to irradiation doses of up to 10^8 rads. When the irradiation dose is increased to 10^9 rads, the compound undergoes destruction, becoming less thermoactive. On physical examination the materials appeared visibly affected: puckering, cracks, color change, etc. (JPRS)

2946 YIELDS OF HYDROGEN PEROXIDE IN TITANIUM SULFATE SOLUTION CONTAINING ALKALI HALIDE FOLLOWING ^{60}Co GAMMA IRRADIATION. Hasegawa, K. (Shizuoka Univ., Japan). Rep. Fac. Sci., Shizuoka Univ.; 8: 47-50(Dec 1973).

When oxygen-saturated titanium sulfate solution containing alkali halides is subjected to ^{60}Co γ-irradiation, the initial yield of H_2O_2 is dependent upon the concentration of alkali halides. The effects of KCl, NaCl, KBr and KF on the molecular H_2O_2 yield show that the yield of H_2O_2 decreases with an increase of the solute concentrations except for KF. The effect of cation indicates the activity-coefficient of alkali metal on dependence of the H_2O_2 yield. It is found that H_2O_2 is formed by combination of OH radicals and further the radical is scavenged with both halide ion and alkali cation in a 0.8 N sulfuric acid solution. (auth)

2947 ESR STUDIES ON GAMMA-IRRADIATED CELLULOSE. Shimada, M. (Gunma Univ., Kiryu, Japan); Nakamura, Y.; Kusama, Y.; Matsuda, O.; Tamura, N. Sen'i Gakkaishi; 30: No. 5-6, T299-T304(May 1974). (In Japanese).

The types of free radicals formed by γ-irradiation in cellulose I and II were studied. The ESR spectra obtained with the γ-irradiated cellulose I and II were changed by contacting the fibers with water, and also the spectra for these fibers after immersion in water were varied by orientations of fiber axes to the magnetic field. These spectra seem to be related to the free radicals generated in the highly ordered regions inaccessible to water in irradiated cellulosic fibers. And the spectral differences between cellulose I and II may be due to the differences in the molecular conformation in the crystal lattices. As a model of typical amorphous regions in cellulose, decrystallized cellulose was prepared. The ESR spectrum of irradiated decrystallized cellulose was simple. When the sample was contacted with moisture, the ESR spectrum changed to a narrow singlet, which gradually decreased the intensity until the spectrum completely disappeared. By subtracting the spectrum of free radicals remaining in decrystallized cellulose after contacting with moisture from the spectrum of decrystallized cellulose, it was found that the types of free radicals formed in the decrystallized cellulose consisted of the overlap of narrow singlet (line width 8G, g-value 2.0050) and doublet (splitting 10G, g-value 2.0045) spectra. The singlet spectrum is attributed to alkoxyl radical formed by the rupture of glycosidic linkage at C_1 or C_4 position, and the doublet spectrum is ascribed to the radical formed by hydrogen abstraction from C_1 position. When the ESR spectra of free radicals formed in the highly ordered regions of the irradiated cellulose I and II were added to the spectra of the singlet and doublet in adequate ratio, the constructed spectra were similar to the spectra of free radicals scavenged by water in cellulose I and II. (auth)

2948 RACEMIZATION OF (D-) MANDELIC ACID BY ^{60}Co-γ-IRRADIATION. Ehrl, A. (Gesellschaft fuer Strahlen-und Umwelforschung mbH, Neuherberg, Ger.). Atomkernenergie; 17: No. 1, 67-72(1971). (GSF-B-292).

Mandelic acid (10^{-3} molar) of the highest purity was dissolved in aerated water and irradiated with ^{60}Co γ rays. During irradiation the decrease of the initial optical rotation of the D(-) mandelic acid was linear. The following products were found by means of spectropolarimetry and UV-absorption spectroscopy: D(-) mandelic acid, L(+) mandelic acid (PhCHOH-COOH), and phenylglyoxylic acid (PhCO-COOH). The stable products analyzed were formed finally by the recombination of the mandelic acid radical (PhC(radical)OH-COOH) with the products of water radiolysis preferentially by the hydrogen atoms (H radical) and the hydroxyl radicals. (GE)

2949 WAVELENGTH–SELECTIVE BLEACHING ("burning holes") IN THE OPTICAL SPECTRA OF TRAPPED ELECTRONS IN ORGANIC GLASSES. Hager, S.L.; Willard, J.E. (Department of Chemistry, University of Wisconsin, Madison, Wisconsin 53706). J. Chem. Phys. 61: No. 8, 3244-3246 (15 Oct 1974).

This paper presents experimental evidence confirming that the broad optical absorption spectra of trapped electrons in glassy 3–methylpentane and methyltetrahydrofuran (MTHF) are convolutions of spectra of electrons trapped with different energies. Laser light of wavelengths near or to the red of the e^-_t optical absorption maximum selectively depopulates electrons which absorb at the bleaching wavelength, thus creating a hole in the e^-_t spectrum. Some additional indications as to the spectral properties of the individual electrons are given by the observations that (1) illumination of e^-_t produced in MTHF at 25°K with laser light to the blue of the absorption maximum results in nearly uniform bleaching throughout the spectrum; (2) e^-_t produced in MTHF at 67°K and illuminated at 25°K with 1064 nm are bleached less efficiently then e^-_t produced at 25°K and have a low probability of being shifted to traps typical of mobile electron trapping at 25°K; (3) the spectra of e^-_t in MTHF are progressively red–shifted as the temperature at which they are produced is lowered from 97 to 10°K, and the resolution of the peaks observable in the spectrum produced at 72°K is lower for spectra of e^-_t produced at higher (97°K) or lower (25 and 10°K) temperatures. Some implications of these observations are discussed. (auth)

2950 ESR AND INDO STUDY OF RADICAL CONFORMATIONS IN IRRADIATED SINGLE CRYSTALS OF l–HISTIDINE FREE BASE. Westhof, E.; Flossmann, W.; Lüdemann, H.; Müller, A. (Lehrstuhl für Physik, Fachbereich Biologie, Universität Regensburg, D–84 Regensburg, West Germany). J. Chem. Phys. 61: No. 8, 3376-3381 (15 Oct 1974).

Radicals produced in x–irradiated single crystals of l–histidine free base in the temperature range 77–300 K have been investigated using ESR spectroscopy at 9.5 and 35 GHz. The main species trapped at 77 K are radical anions located at the carboxyl group. These are converted to deamination radicals upon warming. Conversion of the anion into the deamination radical is not found if the former is bleached by uv illumination at 77 K. At room temperature, only radicals resulting from deamination are observed. Two different conformations of the deamination have been found. The one obtained at room temperature is produced from a precursor with identical composition but different conformation. The latter, which is stable at reduced temperatures, is in the open conformation like both the precursor anion radical and the parent molecule. The room temperature radical however adopts a closed conformation. The identifications are supported by MO–SCF calculations at the INDO level. A detailed analysis of the anion radical and the deamination radical by INDO is presented. (auth)

2951 ELECTRON REACTIONS IN EG/H_2O GLASS. TEMPERATURE DEPENDENCE. Steen, H.B. (Norsk Hydro's Institute for Cancer Research, Department of Biophysics, The Norwegian Radium Hospital, Montebello, Oslo 3, Norway). J. Chem. Phys. 61: No. 8, 3387-3389 (15 Oct 1974).

The decay of x–ray–induced e^-_t in glycol–water glass and the reduction of $G(e^-_t)$ by various scavengers have been studied as functions of the temperature. The decay of e^-_t was independent of temperature from 77 to 113 K as expected if the reaction occurs primarily by electron tunneling. The reduction of $G(e^-_t)$, however, decreased significantly with increasing temperature in the same region, the temperature dependence being larger for less efficient scavengers. The results are qualitatively accounted for by the assumption that a significant fraction of the electrons react prior to formation of stable traps, viz. from shallow, transient traps. (auth)

2952 ESR STUDY OF PAIRED RADICALS IN IRRADIATED SINGLE CRYSTALS OF n–EICOSANE. Hamanoue, K.; Kamantauskas, V.; Tabata, Y.; Silverman, J. (Laboratory for Radiation and Polymer Science, University of Maryland, College Park, Maryland 20742). J. Chem. Phys. 61: No. 8, 3439-3444 (15 Oct 1974).

The pairwise trapping of radicals in γ– and proton–irradiated single crystals of n–eicosane was followed by electron spin resonance measurements. Spectra due to both the $\Delta M_s=1$ and $\Delta M_s=2$ transitions were found. The $\Delta M_s=1$ spectra of the radical pairs show the same hyperfine splitting as that of the $\Delta M_s=2$ spectra. From the spectrum of the $\Delta M_s=1$ transition of paired radicals, the maximum separation due to the zero field splitting in the plane perpendicular to the chain axis was determined to be 287 G; from this the distance of the paired radicals was estimated to be 5.55 and/or 5.67 Å. By the rotation of the crystal axis, 11 peaks change to 22 peaks, indicating that there exist two types of paired radicals. Also the decay of the two types of radical pairs show different temperature dependence. The types of paired radicals are probably in the form of two alkyl radicals on adjacent hydrocarbon chains. The value of 5.55 Å is consistent with the intercarbon distance between two adjacent chains aligned along the direction of the a axis; the 5.67 Å value is consistent with the intercarbon distance between two adjacent chains aligned in the b direction. In addition the LET effect was investigated. The yield of paired radicals appears to be related to the yield of blobs and short tracks. (auth)

2953 ONE-ELECTRON REACTIONS IN SOME COBALAMINS. Blackburn, R.; Erkol, A. Y.; Phillips, G. O.; Swallow, A. J. (Univ. of Salford, Eng.). J. Chem. Soc., Faraday Trans., I; 70: No. 9, 1693-1701(1974).

Pulse radiolysis was used to study the reaction of hydrated electrons and other agents with various cobalamins, viz. cyanocobalamin (vitamin B12), hydroxocobalamin (vitamin B12a), and cob(II)alamin (vitamin B12r). It appears that hydrated electrons react with the cobalt atom of cyanocobalamin with an efficiency of about two-thirds, the product being vitamin B12r. The rate constant for this reaction is 3.8×10^{10} $dm^3\ mol^{-1}\ s^{-1}$. Hydroxyl radicals react with cyanocobalamin with a rate constant of 6.5×10^9 $dm^3\ mol^{-1}\ s^{-1}$ to produce an uncharacterized yellow-brown compound. The radical CO_2^- does not reduce cyanocobalamin to vitamin B12r but reduced hydroxocobalamin with an efficiency of about two-thirds and with a rate constant of 1.45×10^9 $dm^3\ mol^{-1}$ s^{-1}. Vitamin B12r is reduced by CO_2^- with nearly 100% efficiency, the product being cob(I)alamin (vitamin B12s). The rate constant for the reaction is 8.2×10^8 $dm^3\ mol^{-1}\ s^{-1}$. Hydroxyisopropyl radicals do not react with cyanocobalamin but reduce vitamin B12r in a similar fashion to CO_2^-. (auth)

2954 ULTRAVIOLET– AND X–RAY–INDUCED RADICALS IN FROZEN POLAR SOLUTIONS OF L–TRYPTOPHAN. Moan, J.; Kaalhus, O. (Biophysics Department, Norsk Hydros Institute for Cancer Research, Montebello, Oslo 3, Norway). J. Chem. Phys. 61: No. 9, 3556-3566 (1 Nov 1974).

Acid, neutral, and alkaline matrices containing the aromatic amino acid L-tryptophan have been uv and x irradiated at 77 K, and the irradiation products examined by ESR and optical absorption spectroscopy. Three types of tryptophan radicals have been detected: (1) T_{1ox}, supposedly the tryptophan cation, which has a characteristic optical absorption band around 600 nm and a singlet ESR spectrum at $g=2.004$ of width around 25 G, (2) T_{2ox}, probably the radical formed by H abstraction at N_1, which absorbs light around 550 nm and has a narrow singlet ESR spectrum ($g=2.004$, $H=13-14$ G), and (3) T_{red}, assumed to be the radical formed by H addition at C_7, showing an ESR spectrum which is a triplet of triplets with hfs constants $a_1=39$ G and $a_2=12$ G. T_{1ox} is formed by photoionization of tryptophan or by the reaction of tryptophan molecules with x–ray induced oxidized solvent radicals such as Cl_2^- in matrices containing LiCl or HCl, O^- in alkaline solutions, and sulphuric acid radicals in matrices containing H_2SO_4. T_{2ox} is formed by radical conversion of T_{1ox} in acid matrices, and is probably the main oxidized tryptophan radical present in alcohol matrices. T_{red} is formed by the reaction of electrons as well as H atoms with tryptophan molecules. (auth)

2955 ELECTRON-SPIN RESONANCE OF AN X-IRRADIATED SINGLE CRYSTAL OF N-ACETYL-DL-VALINE. Schnepel, G. H. (Univ., Giessen, Ger.). Int. J. Radiat. Biol.; 25: No. 6, 555-564 (Jun 1974).

From congress organized by the Deutsche Gesellschaft fuer Biophysik; Juelich, Germany (27 Sep 1973).

Experiments on radiation-induced radicals in single crystals of N-acetyl-DL-valine are reported. After x-irradiation at room temperature, free radicals with the structures $(CH_3)_2\dot{C}CH(COOH)NHCOCH_3$ and $(CH_3)_2\dot{C}CH_2COOH$ were determined by means of ESR spectroscopy. Earlier experiments on polycrystalline samples had pointed to the formation of the radical $(CH_3)_2\dot{C}CH_2COOH$, but it was impossible to explain the structure of the second radical. In both types of radical, the paramagnetic centre was localized at the C-atom to which the two methyl groups are bonded, and not at the C_α-atom lying in the peptide chain. These two radicals, produced at room temperature, were secondary products in the chain of radio-induced reactions. This result was obtained by ESR spectroscopy of polycrystalline samples after irradiation and measurement at 77°K. Possible reaction sequences are outlined. (auth)

2956 CHEMICAL EFFECTS OF IONIZING RADIATIONS ON CERAMIDE DIGALACTOSIDE AND COMPONENT MOLECULES. Jooyandeh, F.; Moore, J. S.; Phillips, G. O. (Univ. of Salford, Eng.). Int. J. Radiat. Biol.; 25: No. 6, 611-617(Jun 1974).

Stearic acid, galactose, and ceramide digalactoside were γ-irradiated in the solid state. Decarboxylation of stearic acid readily occurred to produce heptadecane ($G = 6.4$) and traces of hexadecane. For stearic acid –G was 11.5 and for galactose was 14; the values were the same in air and in vacuo. Ceramide digalactoside on irradiation gave small amounts of penta and tridecane ($G \sim 9 \times 10^{-3}$). The –G values for disappearance of the stearyl and palmityl moieties were 0.17 and 0.13 respectively. There was also evidence for breakdown of the transolefinic double bond of the sphingosyl residue. Scission of the β-glycosidic bond resulted in the formation of galactose ($G = 1.9$). For the galactose residues –G was 3.7. (auth)

2957 DIPHENYLPHOSPHINO RADICAL, $(C_6H_5)_2P$. Geoffrey, M.; Lucken, E. A. C.; Mazeline, C. (Univ., Geneva). Mol. Phys.; 28: No. 3, 839-845(Sep 1974).

The diphenylphosphino radical, $(C_6H_5)_2\dot{P}$, was observed at room temperature in x-irradiated single crystals of triphenylphosphine oxide and diphenylphosphine sulphide and in ultraviolet irradiated polycrystalline dephenylphosphine at 77°K. The isotropic ^{31}P coupling constant was deduced to be +252 MHz and the anisotropic components are approximately 504, –252, –252 MHz. The largest value of the g tensor lies perpendicularly to the direction of the largest hyperfine coupling constant, the values in diphenylphosphine sulphide being 2.0094, 2.0035, and 2.0021, X-irradiated triphenylphosphine oxide also contains the $(C_6H_5)_2\dot{P}O$ radical. (auth)

2958 IDENTIFICATION OF NEW PRODUCTS IN THE γ-RADIOLYSIS OF DEOXYGENATED SOLUTIONS OF URACIL AND THE EFFECT OF pH. Shragge, P. C.; Varghese, A. J.; Hunt, J. W. (Ontario Cancer Inst., Toronto). J. Chem. Soc., Chem. Commun.; No. 18, 736-738(18 Sep 1974).

A dramatic pH dependence on the yield of radiation-induced uracil destruction was observed, and is attributed to the increased yield of a new radiolytic dimer in acid solution. (auth)

2959 ENZYME IMMOBILIZATION BY COVALENT ATTACHMENT TO NOVEL POLYMER MATRICES PREPARED BY A RADIATION GRAFTING TECHNIQUE. Garnett, J. L.; Kenyon, R. S.; Liddy, M. J. (New South Wales Univ., Kensington, Australia). J. Chem. Soc., Chem. Commun.; No. 18, 735-736 (18 Sep 1974).

By a gamma-irradiation process, p-nitrostyrene was surface grafted onto a representative trunk polymer, polypropylene; conversion of the NO_2 substituent into a suitable functional group (−NCS) gives a water-insoluble matrix to which enzymes may be covalently bound while retaining enzymic activity. (auth)

2960 DECAY OF KINETICS OF THERMOLUMINESCENCE: REMARKS ON A RECENT PAPER BY CHARLESBY, GUPTA, AND SARUP. Rabe, J. G. (Hahn-Meitner-Institut fuer Kernforschung Berlin GmbH). Int. J. Radiat. Phys. Chem.; 6: No. 4, 275-278 (Sep 1974).

It is shown that a model of decay kinetics of thermoluminescence recently presented by Charlesby et al. (Int. J. Radiat. Phys. Chem.; 5: 141(1973)) follows from a more general treatment by Adirowitsch (Einige Fragen zur Theorie der Lumineszenz der Kristalle, Akademie-Verlag, Berlin (1953)). (auth)

2961 RADIOLYSIS OF AQUEOUS SOLUTIONS OF CYSTEINE IN THE PRESENCE OF OXYGEN. Al-Thannon, A. A.; Barton, J. P.; Packer, J. E.; Sims, R. J.; Trumbore, C. N.; Winchester, R. V. (Univ. of Delaware, Newark). Int. J. Radiat. Phys. Chem.; 6: No. 4, 233-248(Sep 1974).

Further experimental data on the radiolysis of cysteine in the presence of oxygen are presented. It is shown that the reaction $RSH^- + O_2 \rightarrow RSH + O_2^-$ which was suggested for mercaptoethanol, does not occur with cysteine, that the radical HOO does not abstract H from cysteine, but that O_2^- does. An attempt was made to rationalize all reported experimental data in terms of two pH-dependent free radical chain reactions involving the following propagating steps: $RS^\cdot + O_2 \rightarrow RSOO^\cdot$; $RSOO^\cdot + RSH \rightarrow RSOOH + RS^\cdot$; and $RS^\cdot + RS^- \rightarrow RS\bar{S}R$; $RS\bar{S}R + O_2 \rightarrow RSSR + O_2^-$; $O_2^- + RSH \xrightarrow{H^+} RS^\cdot + H_2O_2$. The chain terminating reactions are discussed, and it is suggested that the products of reduction of RSOOH by RSH are pH-dependent, H_2O_2 being produced at low pH, and H_2O at $pH > 5$. (auth)

2962 PULSE RADIOLYSIS STUDIES ON CHLORO-COMPLEXES OF PALLADIUM. Broszkiewicz, R. K. (Inst. of Nuclear Research, Warsaw). Int. J. Radiat. Phys. Chem.; 6: No. 4, 249-258 (Sep 1974).

Pulse irradiation of $PdCl_4^{2-}$ and $PdCl_6^{2-}$ in NaCl or HCl solutions indicates that the former may be oxidized or reduced and the latter reduced by the radicals formed in the radiolysis of water. Contrary to previous results on analogue platinum complexes, no structural changes in unstable intermediates were observed, which indicates that probably both palladium complexes react in octahedral symmetry. The spectra, rate constants and extinction coefficients of the intermediate species were determined. (auth)

2963 PULSE RADIOLYTIC INVESTIGATION OF REACTIONS OF DIAMIDE WITH HYDRATED ELECTRONS AND OH-RADICALS. Wold, E.; Brustad, T. (Norsk Hydros Institutt for Kreftforskning, Oslo). Int. J. Radiat. Biol.; 25: No. 4, 407-411(Apr 1974).

2964 RADIATION CHEMISTRY OF ORGANOMETALLIC COMPOUNDS. I. Pulse Radiolysis of Aluminium Alkyl Compounds and Naphthalene in Diethyl Ether. Getoff, N.; Lehmkuhl, H.; Schwoerer, F. (Max-Planck-Institut fuer Kohlenforschung, Muelheim, Ger.). Int. J. Radiat. Phys. Chem.; 6: No. 4, 259-269 (Sep 1974). (In German).

Solutions of triethyl aluminium (TEA), diethyl aluminium (DEA) chloride, and naphthalene as well as mixtures of TEA + naphthalene and DEA chloride + naphthalene in diethyl ether were studied by pulse radiolysis. The transients formed from triethyl aluminium have a total absorption spectrum from 220 to 340 nm. They disappear according to mixed-order kinetics. The spectra of R_2Al-species produced from diethyl aluminium chloride show two peaks (at 240 and 320 nm), which decay by second-order kinetics. The spectra and kinetic data of the naphthalene radical anion ($C_{10}H_8^-$; maxima at 330 and 370 nm) and of the hydronaphthyl radical ($C_{10}H_9$, maxima at 300, 307, 320 nm) were also obtained. Recording the total absorption spectrum of the triethyl aluminium-naphthalene-ether system at various times after the pulse led to the observation of a new maximum at 312 nm. (auth)

2965 PULSE-RADIOLYSIS OF GLYCINE AND ALANINE AT pH 0-7. Markovic, V.; Nikolic, D.; Micic, O. I. (Institut za Nauk Boris Kidric, Belgrade). Int. J. Radiat. Phys. Chem.; 6: No. 4, 227-232(Sep 1974).

The absorption spectra of transients formed in the reaction of e_{aq}^- with glycine and α-alanine are given. It is shown that the reaction: $NH_3^+CH(R)COOH + e_{aq}^- \rightarrow NH_3 + \dot{C}H(R)COOH$ takes place in acid aqueous solution. Both glycine and alanine react with e_{aq}^- about 1000 times faster in the protonated form, at low pH, than in neutral medium. This effect was taken into account and approximate values of the pK's of both α-aminocarboxyl radicals are determined. (auth)

2966 CALCULATION OF ELECTRON SOLVATION TIMES FOR SEVERAL DIPOLAR LIQUIDS. Schiller, R.; Vass, S. (Kozponti Fizikai Kutato Intezet, Budapest). Int. J. Radiat. Phys. Chem.; 6: No. 4, 223-226(Sep 1974).

An earlier theory on the kinetics of electron solvation is developed further and evaluated numerically. Comparing the theoretical predictions with recent experimental results the agreements seem to be reasonable particularly for liquids of fast dielectric relaxation. This finding supports the view that electrons become solvated by self-trapping. (auth)

2967 PURINE DNA BASE CATION AND ANION RADICALS. An ESR Study. Sevilla, M. D.; Mohan, P. A. (Oakland Univ., Rochester, MI). Int. J. Radiat. Biol.; 25: No. 6, 635-638(Jun 1974).

The cation and anion radicals of the purine DNA bases were studied in neutral aqueous glasses by ESR methods, to determine the g values of the purine ion radicals for comparison to those found in polycrystalline purines, and to investigate possible protonation reactions of the purine anions in a neutral aqueous medium. Comparison of the results with earlier work on purines and pyrimidines showed that, of the four DNA bases, the thymine anion most readily protonates. It is suggested that these results give the probable explanation for the fact that only the thymine anion has been found to protonate in gamma-irradiated DNA. (UK)

2968 YIELD OF SOLVATED ELECTRONS IN THE ALIPHATIC ALCOHOLS AT PICOSECOND TIMES. Lam, K. Y.; Hunt, J. W. (Univ. of Toronto). J. Phys. Chem.; 78: No. 23, 2414-2416(7 Nov 1974).

Results of infrared spectral studies in the 800 to 1100-nm region indicate that the spectrum of e_{aq}^- at 30 psec resembles that in microsecond times, but it is not true for the e_{sol}^- in alcohols. In methanol, ethanol, 1-propanol, and 2-propanol, there are large absorption signals in the ir region after 30 psec. These signals decay in a time of about 30 to 250 psec, leaving absorption signals whose spectra resemble those of the normal e_{sol}^- in these alcohols. Spectral changes were completed in 150 psec in both methanol and ethanol and in 250 psec in 1-propanol and 2-propanol, so determination of g values could be made at these times. Kinetic traces of the absorption signals in various media at 1000 nm at room temperature are given. (JGB)

2969 CONTRIBUTION TO THE RADIATION PREPARATION OF WOOD-PLASTIC MATERIALS. VII. The Combination of Thermal and Radiation Polymerization in the Preparation of WPC. Piatrik, M.; Varga, S. (Slovak Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 19: No. 3, 191-196(25 Oct 1974).

The possibility of the combined use of heat technology in the preparation of WPC with radiation was demonstrated. The course of heat polymerization of styrene in block polymerization in wood without chemical initiator, in the presence of dibenzoylperoxide, and also the combination of thermal and radiation polymerization in the preparation of WPC was studied. (auth)

2970 PREPARATION AND PROPERTIES OF MEMBRANES OBTAINED BY RADIATION INDUCED GRAFTING OF 4-VINYLPYRIDINE ONTO POLYTETRAFLUORETHYLENE FILMS. Canepa, G.; Munari, S.; Rossi, C.; Vigo, F. (Univ., Genoa). Desalination; 13: No. 2, 159-170(Oct 1973).

The preparation and properties of membranes obtained by radioinduced grafting are described, using vinylpyridine (VPy) on a poly-(tetrafluorethylene) (PTFE) matrix. Subsequent quaternization of the pyridine groups improves greatly the hyperfiltration properties of these membranes, considering both flux and rejection, and they may be developed for desalination purposes. The dependence of grafting yields on irradiation times was studied as well as the thermal and chemical properties of the membranes obtained. Flux and rejection to NaCl of quaternized VPy/PTFE membranes was measured as a function of various chemical and physical properties. (NL)

2971 SELECTION OF OPTIMAL CONDITIONS FOR RADIATION VULCANIZATION OF FLUOROELASTOMERS. Kryukova, A. B.; Makhlis, F. A.; Treshchalov, V. I.; Kuz'minskii, A. S. Kauchuk Rezina; No. 5, 11-13(1974). (In Russian).

The effect of the medium, temperature and γ-radiation absorption dose on the process rates of structuralization and destruction of the fluoroelastomers SKF-32, SKF-260 and SKF-26-1 was studied. Radiation vulcanization of fluoroelastomers should be carried out in water at about 40°C. The optimal absorption doses should be selected on the basis of the work conditions of specific finished products. (JPRS)

2972 STUDY OF THE REDISTRIBUTION OF ABSORBED ENERGY IN γ-IRRADIATED SALTS WITH THE FORMATION OF IMPURITY PARAMAGNETIC CENTERS AS AN EXAMPLE. Spitsyn, V. I.; Ionova, G. V.; Barsova, L. I.; Popova, G. Yu. (Inst. of Physical Chemistry, Moscow). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 23: No. 3, 510-514(Mar 1974).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 23: No. 3, 540-545(Mar 1974).

The principles of formation of impurity paramagnetic centers (PC) in γ-irradiated salts with oxygen-containing anions were established. The probability of formation of hole PC in γ-irradiated salts is determined by the ratio of the ionization potentials of the anions of the matrix and impurity: PC arise only in the case when the ionization potential of the impurity anion is lower than the corresponding value for the anion of the matrix. The probability of formation of electronic PC is related to the electron affinity of the corresponding oxyanions. The appearance of impurity PC in γ-irradiated salts containing impurity anions is associated with the transfer of free electrons and holes from the matrix to the impurity. (auth)

2973 PULSE RADIOLYSIS OF LIQUID METHYLAMINE, ETHYLAMINE, AND AMMONIA: THE YIELD OF SOLVATED ELECTRONS. Seddon, W. A.; Fletcher, J. W.; Sopchyshyn, F. C.; Jevcak, J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Chem.; 52: No. 18, 3269-3278(15 Sep 1974).

Yields of solvated electrons, G, have been measured in both the pure and basic solvents using biphenyl and pyrene as electron scavengers. In pure methylamine and ethylamine $G = 2.2 \pm 0.1$ and $1.8_4 \pm 0.1$, respectively. However in basic solution these yields more than double giving $G = 4.75 \pm 0.2$. In liquid NH_3 and ND_3 at −15°C, $G = 3.1_7 \pm 0.15$ and 3.6 ± 0.2, respectively. The latter yields seem independent of base and temperature from −15 to −50°C. Comparisons with previous work are discussed. (auth)

2974 PULSE RADIOLYTIC FORMATION OF SOLVATED ELECTRONS, ION-PAIRS, AND ALKALI METAL ANIONS IN TETRAHYDROFURAN. Salmon, G. A.; Seddon, W. A.; Fletcher, J. W. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Chem.; 52: No. 18, 3259-3268(15 Sep 1974).

Pulse radiolysis of solutions of alkali metal cations in tetrahydrofuran (THF) demonstrates the formation of solvated electrons, alkali metal cation—ion pairs, and alkali metal anions. This paper describes the spectra, extinction coefficients, and radiolytic yields of solvated electrons, lithium, sodium, potassium, and cesium species in THF. (auth)

2975 EFFECT OF FAST ELECTRONS ON THE STRUCTURE OF POLY(ETHYLENE TEREPHTHALATE). Kozyreva, M. S.; Konovalov, L. V.; Kononenko, Z. I. Vysokomol. Soedin., Ser. B; 16: No. 7, 548-549(Jul 1974). (In Russian).

Spectra in the mid and far infrared region, in natural and polarized light, for poly(ethylene terephthalate) films that had been irradiated with 2, 100, or 500 Mrads of fast electrons are shown. The spectra indicate a reorientation of the chain and an increase in the amorphous phase in the 500-Mrad irradiated samples. However, there was no evidence of cross-linking. (MG)

2976 ELECTRON SPIN RESONANCE OF γ-IRRADIATED SALTS OF DIETHYL PHOSPHORIC ACID. Ezra, F. S.; Bernhard, W. A. (Univ. of Rochester, NY). Radiat. Res.; 60: No. 2, 350-354(Nov 1974). (UR-3490-421).

The Mg^{2+}, K^+, Zn^{2+}, Ba^{2+}, Co^{2+}, Ag^+, and Cd^{2+} salts of diethyl phosphoric acid have been γ-irradiated and observed by ESR in the temperature range between 77 and 300°K. The yield of the $\dot{C}H_3CHOP(O)_2OC_2H_5^-$ radical is relatively independent of the associated cation, whereas formation of the $CH_3\dot{C}H_2$ and $C_2H_5O\dot{P}O_2^-$ radicals is depressed, or absent, in the Co^{2+}, Ag^+, and Cd^{2+} salts. It is concluded that the ethyl and ethylphosphite radicals are formed by dissociative electron attachment and that formation of $\dot{C}H_3CHOP(O)_2OC_2H_5^-$ is independent of electron addition. (auth)

2977 RADIOLYSIS OF URACIL IN THE ABSENCE OF OXYGEN. Shragge, P. C.; Varghese, A. J.; Hunt, J. W.; Greenstock, C. L. (Univ. of Toronto). Radiat. Res.; 60: No. 2, 250-267(Nov 1974).

The stable products resulting from the radiolysis of uracil in deoxygenated solutions have been characterized, and their yields have been measured. The G-value for the destruction of uracil varies from 4.6 at pH 5 to 1.5 at pH 9 in the presence of N_2O, and from 3.3 at pH 5 to 0.7 at pH 9 in the presence of N_2. In both cases, a plot of the G-value against pH follows a titration curve with a pK_a of approximately 7. The G-value does not depend on pH if the solutions contain 0.2 M t-butanol or oxygen. We have isolated two classes of stable products: monomeric products and dimers. The first class of products includes uracil glycols, uracil hydrates, and dihydrouracil. The dimeric products, which have not been observed before, have a variety of structures, but they all consist of two saturated pyrimidine rings joined by a single bond. The yield of dimers is more pH dependent than the yields of the monomeric products; however, the dimers are the major products under all conditions studied. In addition, the properties of the dimers depend on the pH of the solution and on the gas present. We present a mechanism which explains (i) how the different types of products arise by reactions of the transient uracil adducts with themselves and each other, and (ii) how the state of dissociation of the transient uracil adducts causes the observed pH dependence of the G-values. (auth)

2978 PULSE RADIOLYSIS STUDY OF THE FREE RADICAL INTERMEDIATES IN THE RADIOLYSIS OF URACIL. Shragge, P. C.; Hunt, J. W. (Univ. of Toronto). Radiat. Res.; 60: No. 2, 233-249(Nov 1974).

The technique of pulse radiolysis has been utilized to study the absorption spectra of the transient free radical adducts which result from reactions of ·OH and e_{aq}^- with the pyrimidine, uracil. The ·OH attaches to the 5,6 bond of uracil to form an adduct (·UOH) which has peaks at 390 nm and ~240 nm. Changes in the spectrum of ·UOH with pH have led us to the conclusion that at least one isomer of ·UOH has pK_a's of ~7 and 9.5. The ·UOH decays by a second order kinetics with rate constants, $2k = (1.1 \pm 0.2) \times 10^9\ M^{-1}\ s^{-1}$ which is independent of ionic strength. There is a residual spectrum which remains after the decay of the ·UOH absorption. This residual spectrum is different at pH 5 and 8.5, and shows a similar pH dependence to that of ·UOH itself. The e_{aq}^- adds to uracil to form an adduct which has protonated ($\cdot UH_1$) and unprotonated ($\cdot U^-$) forms which are in equilibrium with a pK_a of 7. The spectra of both $\cdot UH_1$ and $\cdot U^-$ both have peaks near 250 nm with shoulders near 300 nm. The spectrum $\cdot U^-$ is more intense than that of $\cdot UH_1$. The rate constant for protonation of $\cdot UH_1$ is $(5.7 \pm 0.4) \times 10^{10}\ M^{-1}\ s^{-1}$. Both $\cdot UH_1$ and $\cdot U^-$ decay by second order kinetics with rate constants, $2k = (2.5 \pm 0.5) \times 10^9\ M^{-1}\ s^{-1}$ and $2k = (1.6 \pm 0.3) \times 10^9\ M^{-1}\ s^{-1}$, respectively. Evidence is presented which indicates that a reaction between $\cdot UH_1$ (or $\cdot U^-$) and an absorbing product may occur. In Ar bubbled solution with no scavengers present, the observed spectrum agrees closely with the calculated sum of the spectra of the individual adducts. This spectrum also decays by second order kinetics with the same halflife at all wavelengths implying that the adducts decay by reaction with themselves and with each other. (auth)

2979 ENERGY LEVEL STRUCTURE AND MOBILITY OF EXCESS ELECTRONS IN γ-IRRADIATED 5 M POTASSIUM CARBONATE AQUEOUS GLASSES. Effect of Ions on Trapped and Mobile Electrons in Aqueous Glasses. Noda, S.; Kevan, L. (Wayne State Univ., Detroit). Contract AT(11-1)-2086. J. Phys. Chem.; 78: No. 24, 2454-2460(21 Nov 1974).

The energy level structure of trapped electrons (e_t^-) in γ-irradiated 5 M K_2CO_3 glassy ice at 77°K has been investigated via the wavelength dependence of the photocurrent. Scavenger effects demonstrate that the photogenerated charge carrier is an electron. The photocurrent wavelength response per unit incident photon does not coincide with the optical absorption band of the e_t^- and can be phenomenologically resolved into two bands. The optical absorption band is symmetrically bleached with monochromatic light and can also be resolved into at least two subbands. The photocurrent band at longer wavelength coincides with the longer wavelength absorption band. Thus the e_t^- in the shallower potential wells appear to have no bound excited state as is the case for e_t^- in 10 M NaOH glassy ice. For e_t^- in the deeper potential wells, the shorter wavelength absorption and photocurrent bands do not coincide and indicate a bound excited state as is found for e_t^- in crystalline ice. The difference between the energy level structure for e_t^- in different aqueous matrices can be understood in terms of a semicontinuum model of electron trapping and the modification of the polarization interactions by the ions present in the matrix. The analysis is supported by the photocurrent wavelength dependence in 4.5 M D-glucose glassy ice. The field and temperature dependence of the photocurrent and the electron drift mobility were also investigated. Superohmic photocurrents are observed in certain dose ranges at 77°K. The electron drift mobility is inversely proportional to field at high fields and exhibits a negative temperature dependence from 80 to 103°K. The dominant scattering mechanism near 77°K for photoexcited mobile electrons is lattice phonon scattering. In contrast to e_t^- in 10 M NaOH ice, the mobility is independent of the hole (CO_3^-) concentration and there appear to be no shallow traps relative to the conduction band associated with CO_3^-. These differences are explained in terms of the different degree of lattice polarization induced by CO_3^- and O^- ions in aqueous matrices. (auth)

2980 ISOTOPE EFFECT IN THE DECAY OF TRIPLET-STATE RADICALS IN X-RAY IRRADIATED CARBOHYDRAZIDE. McLain, W. L. III; Haven, Y.; Shields, H. (Wake Forest Univ., Winston-Salem, NC). Radiat. Res.; 60: No. 2, 226-232(Nov 1974).

A deuterium-hydrogen isotope effect has been observed in the decay of triplet-state radicals in the temperature range 183-236°K in carbohydrazide x-ray irradiated at 77°K. Triplet-state radicals decayed 50 times faster in nondeuterated samples than in deuterated samples. The decay curves were matched to curves from diffusion theory, but they could not be adequately matched to curves from a single first or second-order process. The decay rates as a function of temperature can be described with the Arrhenius equations: $k_{11}(H) = 3.1 \times 10^3 \exp(-0.27\ eV/k_B T)\ sec^{-1}$; $k_{11}(D) = 4.5 \times 10^5 \exp(-0.43\ eV/k_B T)\ sec^{-1}$. (auth)

2981 STAIN-REPELLENT FINISHING OF COTTON CLOTHS BY GAMMA- AND ULTRAVIOLET-RAY VAPOR-PHASE GRAFTING OF FLUOROALKYL ACRYLATES. Hayakawa, K.; Kawase, K.; Iwasaki, M. (Government Industrial Research Inst., Nagoya, Japan). Nagoya Kogyo Gijutsu Shikensho Hokoku; 22: No. 11, 435-443(Nov 1973). (In Japanese).

Graft copolymerizations of several fluoroalkyl acrylates and other monomers onto cotton cloths using the vapor-phase method were carried out under γ- or ultraviolet-irradiation, and the water- and oil-repellencies of the grafted swatches were examined. The UV-ray simultaneous irradiation technique proved to be the most favorable for the practical grafting. The large fraction of the polymer formed on the cloth by UV irradiation was found to be truly grafted to the cloth. The hydrophobic property was bestowed to the swatches grafted with the monomers which possess longer ester groups, whereas the oil-repellent cloths were obtained only with the grafting of the monomers which possess CF_3- at the end of the alkyl groups. These properties were independent of the extent of grafting, and essentially unaffected by the laundering or extraction. (auth)

2982 DEGRADATION OF NUCLEIC ACID IN AQUEOUS SOLUTION BY IONIZING RADIATION. I. Loss of Ultra-Violet Absorption of Solutions by Thymine or Thymine Derivatives on X-Irradiation. Hoard, D. E.; Hayes, F. N.; Goad, W. B. (Los Alamos Scientific Lab., NM). Int. J. Radiat. Biol.; 25: No. 6, 603-609(Jun 1974).

Irradiation of solutions of thymidine or ammonium thymidylate with 250-kV x rays at neutral pH resulted in more rapid loss of ultraviolet absorption under inert atmosphere than in air. The opposite behaviour with respect to the presence of oxygen was manifested by thymine solution. The effect of oxygen during irradiation on the ultraviolet absorption of solutions of poly d-T was more like its effect on thymidine or thymidylate solutions than on solutions of thymine. (auth)

2983 STUDIES ON THE EFFECTS OF GAMMA RADIATION ON SOME SEMISYNTHETIC PENICILLINS, N, N′-DIBENZYLETHYLENEDIAMINE ACETATE AND N, N′-DIBENZYLETHYLENEDIAMINE BENZYLPENICILLIN SALT BY THE EPR METHOD AT 123°K. Dziegielewski, J. O.; Jezierski, A.; Jezowska-Trzebiatowska, B.; Kozlowski, H. (Univ., Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 22: No. 7, 635-641(Aug 1974).

Solid samples of aminobenzylpenicillin, carboxybenzylpenicillin, N,N′-dibenzylethylenediamine acetate and debecillin were irradiated with doses of 0.5 to 2.0 Mrads at liquid nitrogen temperature and then subjected to EPR studies at 123 to 300°K. No effect of the dose on the nature of EPR spectra was found. The irradiated samples were found to contain the radicals whose nature indicated the influence of crystallization water and the organic cation attached to the −COOH group in penicillin on the mechanism of radiolysis in penicillins. (auth)

2984 TRANSIENT AND STABLE PRODUCTS IN THE PULSE RADIOLYSIS OF SOME DIHYDROPYRIMIDINE SOLUTIONS. Barszcs, D.; Fielden, E. M. (Inst. of Cancer Research, Sutton, Eng.). Int. J. Radiat. Biol.; 25: No. 6, 539-553(Jun 1974).

The radiation chemistry of three 5,6-dihydropyrimidines (DHU, 5-Me-DHU, 6-Me-DHU) was investigated by pulse radiolysis. Some rate constants for the reaction of the primary water radicals, OH, H, and e_{aq}-, with these compounds are reported. Reaction with e_{aq}- gave transient absorptions below 500 nm without a defined peak. Reaction with either H or OH radicals, however, produced transient spectra with, in all cases, a well defined peak (~ 400 nm) and a shoulder (~ 300 nm) on the end absorption. The decay kinetics at 400 nm were second order, whereas they were first order at 300 nm. The two transient species so distinguished were assigned as the 5-yl and 6-yl radical, respectively. The yields of the corresponding pyrimidines are reported with a discussion of the chemistry of the intermediate radicals. (auth)

2985 DEVELOPMENT OF RADIATION CHEMISTRY IN THE SOVIET UNION (FOR THE TWO HUNDRED AND FIFTIETH ANNIVERSARY OF THE ACADEMY OF SCIENCES OF THE USSR). Bakh, N. A. High Energy Chem. (USSR) (Engl. Transl.); 8: No. 3, 163-174(1974).

Translated from Khim. Vys. Energ.; 8: No. 3, 195-210(1974).

The discussion of the development of radiation chemistry in the USSR covers the following areas: elementary processes; reactions in gases exposed to ionizing radiations; radiolysis of water and aqueous solutions; radiolysis of organic compounds; and radiation chemistry of polymers. (No references). (LK)

2986 ABSORPTION SPECTRA OF ELECTRONS STABILIZED IN ALCOHOLS AT LOW TEMPERATURES. Vannikov, A. V.; Rudnev, R. V.; Zimina, G. M. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 3, 208-211(1974).

Translated from Khim. Vys. Energ.; 8: No. 3, 250-254(1974).

A study was carried out of the optical absorption spectra of e_{st}^- at 77°K in isobutanol, isopentanol, isopropanol, and n-butanol-2. From an analysis of the yield-dose curves for e_{st}^- obtained at various wavelengths, and from the results of photobleaching experiments, it was concluded that the spectrum of e_{st}^- has a complex structure. The temperature shift of the spectrum due to e_{solv}^- in isopropanol was investigated. It was found that the e_{solv}^- spectrum is shifted, with a constant coefficient, towards shorter wavelengths as the temperature is reduced. Generation of e_{st}^- by electron irradiation of isopentanol at a temperature ~ 20° below the freezing point, and subsequent temperature reduction to 77°K, leads to stabilization of the electron, a feature of which is preservation of polar group mobility at the irradiation temperature. From a comparison of the e_{st}^- spectra obtained at 77 and 135 ± 5°K, the orientation energy of the alcohol molecule in the field of an electron was found to constitute ~ 15% of the solvation energy. (auth)

2987 PULSE RADIOLYSIS OF AQUEOUS SOLUTIONS OF POTASSIUM CHROMATE. Kabakchi, S. A.; Zansokhova, A. A.; Pikaev, A. K. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 3, 212-216(1974).

Translated from Khim. Vys. Energ.; 8: No. 3, 255-260(1974).

The radiolytic conversions occurring in neutral aqueous solutions of potassium chromate under various conditions were investigated by the pulse radiolysis method. It is shown that radiolysis of the chromate system is a useful method for the study of proton transfer reactions and of various effects of nonhomogeneity. (auth)

2988 MECHANISM OF THE RADIATION OXIDATION OF AQUEOUS ALCOHOL SOLUTIONS CONTAINING DIVALENT IRON. Pribush, A. G.; Brusentseva, S. A.; Shubin, V. N.; Dolin, P. I. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 3, 217-219(1974).

Translated from Khim. Vys. Energ.; 8: No. 3, 261-264(1974).

The rates of accumulation of Fe^{3+} and acetone, formed by the radiolysis of aqueous acidic solutions of isopropyl alcohol containing added Fe^{2+} ions, were studied as functions of the Fe^{2+} and alcohol concentrations, dose, and dose rate. The yields of the radiolysis products do not depend on dose rate and isopropyl alcohol concentration. A mechanism is suggested for the radiolysis over the whole range of Fe^{2+} concentrations studied. The ratio of the rate constants for the reactions of the peroxy hydroxyalkyl radical with Fe^{2+} and Fe^{3+} was determined. (auth)

2989 RADIATION-INDUCED HYDROGEN EXCHANGE BETWEEN ACETONE AND TRITIUM OXIDE. Kalyazina, N. S.; Moskalev, Yu. I. (Inst. of Biophysics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 3, 224-226(1974).

Translated from Khim. Vys. Energ.; 8: No. 3, 270-272(1974).

On irradiation of dilute solutions of acetone in water containing tritium oxide, labeled acetone is formed. The radiation chemical exchange yield rises with increasing acidity, reaching 250 molecules/100 eV in 3 M sulfuric acid solution. An exchange mechanism is proposed on the basis of the protonation of acetonyl radicals and their subsequent rearrangement. (auth)

2990 PHOTOCHEMICAL REACTIONS IN IRRADIATED POLYETHYLENE. Vasilenko, V. V.; Klinshpont, E. R.; Milinchuk, V. K. (Physical Chemistry Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 3, 227-231(1974).

Translated from Khim. Vys. Energ.; 8: No. 3, 273-278(1974).

UV and ESR methods were used to investigate the formation and reactions of free radicals and polyenes in low-density polyethylene (PE) and deuterated polyethylene (DPE) exposed to ionizing radiations. The exposure of γ-irradiated PE and DPE to UV light in vacuum at 77°K yields dienyl, trienyl, and tetraenyl radicals and their corresponding polyenes. It was found that both the radicals and the polyenes disappear from irradiated PE at 300°K in the presence of oxygen. Oxidation of the polyenes occurs only when free radicals are present in PE. On exposure to UV light the dienes react with oxygen to form oxygenated groups in the PE. Possible mechanisms for the oxidation of irradiated PE involving the participation of free radicals and polyenes are discussed. (auth)

2991 COMPARISON OF THE POLYMERIZATION RATES OF CH_2O AND CD_2O AT 5 TO 10°K IN A ^{60}Co GAMMA-RAY FIELD. Gol'danskii, V. I.; Kiryukhin, D. P.; Barkalov, I. M. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 3, 232(1974).

Translated from Khim. Vys. Energ.; 8: No. 3, 279(1974).

2992 IMPROVEMENT OF LOW-TEMPERATURE STABILITY OF LOW-DENSITY POLYETHYLENE BY ELECTRON IRRADIATION. Sirota, A. G.; Nalivaiko, E. I.; Ryabikov, E. P. High Energy Chem. (USSR) (Engl. Transl.); 8: No. 3, 235-236(1974).

Translated from Khim. Vys. Energ.; 8: No. 3, 281-282(1974).

2993 RADIATION STUDIES OF ARYL GLYCOSIDES. VI. Radicals Derived from Phenyl Beta-D-Glucopyranosides. Baugh, P. J.; Kershaw, K.; Phillips, G. O.; Webber, M. G. (Salford Univ., Eng.). Carbohyd. Res.; 31: No. 2, 199-209(Dec 1973).

Radicals formed by γ-irradiation of o-, m-, and p-substituted-phenyl β-D-glucopyranosides were studied in the polycrystalline state, in glassy methanol, and in frozen, aqueous solution. Substituted cyclohexadienyl radicals and radicals derived from the D-glucopyranosyl group are evident after irradiation of the compounds in the solid state and in frozen, aqueous solutions. Cyclohexadienyl radicals are more stable during thermal annealing and are present in 2 to 3 times greater yield than the sugar radicals. p-Hydroxy- and methoxy-phenyl β-D-glucopyranosides yield phenoxy radicals, which can be transformed into substituted cyclohexadienyl radicals by thermal annealing. Hydrogen abstraction and inter- and intra-molecular hydrogen-transfer are the most likely processes leading to the radicals that have been identified. (auth)

Radiochemistry and Nuclear Chemistry

Hot-Atom Chemistry

2994 (ORO-3898-20) GROUND ELECTRONIC STATE OF SILYLENE. Zeck, O. F.; Su, Y. Y.; Gennaro, G. P.; Tang, Y. N. (Texas Agricultural and Mechanical Univ., College Station (USA). Dept. of Chemistry). 1973. 29p. Dep. NTIS $4.50.

Silylene-^{31}Si adds to 1,3-butadiene to give silacyclopent-3-ene-^{31}Si. Studies using nitric oxide as a scavenger demonstrate that the reacting silylene is present as 80% triplet and 20% singlet, while studies using neon as a moderator prove that the ground electronic state of silylene is a singlet. (auth)

2995 (ORO-3898-21) CONSECUTIVE UNIMOLECULAR DECOMPOSITION FOLLOWING RECOIL TRITIUM ACTIVATION OF 1,1-DIFLUOROETHANE. Smith, W. S.; Tang, Y. N. (Texas Agricultural and Mechanical Univ., College Station (USA). Dept. of Chemistry). [nd]. Contract AT(40-1)-3898. 21p. Dep. NTIS $4.25.

Excited $C_2H_3TF_2$ formed by T*-for-H substitution in CH_3CHF_2 gives C_2H_2TF and C_2HT as the secondary and tertiary decomposition products, respectively. The observed trends demonstrate that the $C_2H_3TF_2$ yield increases the C_2HT yield decreases, while the C_2H_2TF yield exhibits a maximum with increasing pressure. These trends are consistent with a mechanism of consecutive unimolecular decomposition in which all the excitation energy is introduced during the initial substitution. (auth)

2996 (ORO-3898-22) GAS PHASE RECOIL PHOSPHORUS REACTIONS. III. Systematic Study of Hydrogen-Abstraction Reactions. Zeck, O. F.; Gennaro, G. P.; Tang, Y. N. (Texas Agricultural and Mechanical Univ., College Station (USA). Dept. of Chemistry). 1974. Contract AT(40-1)-3898. 29p. Dep. NTIS $4.50.

The relative efficiencies of H-abstraction by recoil ^{32}P atoms from eight hydrogen-containing molecules (AH_x) have been measured. A plot of the H-abstraction efficiency vs AH_x bond dissociation energy yielded a good correlation curve identifying bond strength as a major controlling parameter for such reactions. Moreover, when the heats of reaction for $^{32}PH_3$ formation with assumed one-, two-, or three-step abstraction mechanisms were compared with the experimental results, the conclusion was reached that the abstraction of three H atoms from SiH_4 occurs simultaneously, and that the H-abstraction from hydrocarbons requires energetic ^{32}P atoms and is likely to involve a stepwise mechanism. (auth)

2997 (ORO-3898-23) HOT ATOM REACTIONS INVOLVING MULTIVALENT AND UNIVALENT SPECIES. Progress Report, February 1974–January 1975. Tang, Y. N. (Texas Agricultural and Mechanical Univ., College Station (USA). Research Foundation). 1974. Contract AT(40-1)-3898. 18p. Dep. NTIS $4.00.

Significant progress has been made during this period in the study of recoil ^{31}S and ^{32}P reactions. A study of recoil ^{11}C reactions has also been initiated. For the recoil ^{31}Si systems, we have completed the work designed to ascertain that the ground electronic state of silylene is a singlet. The effect of scavengers on the addition of silicon-31 difluoride to 1,3-butadiene has also been studied. The observed results can be explained by the supposition that singlet $^{31}SiF_2$ always adds to 1,3-butadiene to give difluorosilacyclopent-3-ene-^{31}Si, while triplet $^{31}SiF_2$ forms complexes with scavenger molecules, possessing unpaired electrons. Such complexes then act as $^{31}SiF_2$ donors towards 1,3-butadiene to give the same final product. For recoil ^{32}P systems, the relative efficiencies of H-abstraction from eight H-containing molecules have been measured and a major controlling parameter for such reactions was found to be bond strength. A significant deduction from these results is that the abstraction of three H atoms from SiH_4 by a ^{32}P atom occurs simultaneously in a single step. The study of recoil ^{11}C atoms with 1,3-butadiene has been initiated. Carbon-11 labeled 1,2,4-pentatiene, 1-penten-4-yne and 1,3-cyclopentadiene were all observed as products. (auth)

2998 RICE-RAMSPERGER-KASSEL-MARCUS THEORY APPLIED TO DECOMPOSITION OF HOT ATOM SUBSTITUTION PRODUCTS: C_4H_7T AND c-C_4D_7T. Chou, C. C. (Univ. of California, Irvine); Hase, W. L. J. Phys. Chem.; 78: No. 23, 2309-2315(7 Nov 1974).

The RRKM theory was used to interpret experimental measurements of the decomposition of excited c-C_4H_7T and c-C_4D_7T following T-for-H and T-for-D substitution in recoil tritium experiments. An expression was obtained for calculating the pressure dependence of decomposition to stabilization. It was found that (1) rotational effects are unimportant for either c-C_4H_7T or c-C_4D_7T decomposition; (2) when the excitation function for T-for-H substitution in c-C_4H_8 is approximated by one derived from molecular beam experiments, the displaced H atoms carry on the average 40% or more of the incident T translational energy; (3) for similar T-for-H and T-for-D excitation functions, displaced H and D atoms have nearly the same average kinetic energies. (auth)

2999 RECOIL TRITIUM REACTIONS WITH SPIROPENTANE: PRIMARY HOT INTERACTIONS AND SECONDARY UNIMOLECULAR DECOMPOSITION. Su, Y. Y. T. College Station, TX; Texas A and M Univ. (1974). 164p. University Microfilms Order No. 74-21,229.

Thesis (Ph. D.).

In recoil tritium reactions with spiropentane, the primary products, including those from abstraction, substitution and ring-opening processes, were all measured. Spiropentane-t molecules, excited by T-for-H substitution, underwent unimolecular processes by two different routes: one is the direct decomposition process and the other is the consecutive isomerization-decomposition process. In the former case the excited spiropentane-t molecules decomposed directly to C_2H_3T and C_3H_3T, while in the latter case the excited molecules isomerized to excited methylenecyclobutane-t molecules which then decomposed to give the same end products. The unimolecular nature of the reaction was verified by pressure studies from 79 to 4462 torr. The C_2H_3T/C_3H_3T ratios from these samples with the total pressure lower than 300 torr were all approximately equal to 1.0. This leads to the conclusion that nonrandomized decomposition is only a minor or negligible process in the employed pressure range. However, as the total pressure of the system became higher than 300 torr, this ratio began to deviate from unity. The ratio became lower than unity as the total pressure was increased. At the highest total pressure (4462 torr) this ratio is 0.76 ± 0.02 compared to that of 0.90 ± 0.02 at 1610 torr. The presence of this deviation confirmed that a small but finite fraction of the energy nonrandomized decomposition was actually present in the system which became more obvious at high pressures. (Diss. Abstr. Int., B)

3000 CARRIER-FREE BIS-ACETYLACETONATO COBALT (II) PRODUCED FROM NEUTRON IRRADIATED TRIS-ACETYL-ACETONATO COBALT(III), AS IDENTIFIED BY SUBLIMATION METHOD. Amano, R.; Sakanoue, M. (Kanazawa Univ., Japan). Radiochem. Radioanal. Lett.; 19: No. 3, 197-200(25 Oct 1974).

By using sublimatographic separation, carrier-free ^{60}Co(II) (acetylacetonato)$_2$ was found in the neutron-irradiated Co(III) (acetylacetonato)$_3$ matrix, though no ^{60}Co(III) (acetylacetonato)$_3$ was formed in the irradiated Co(II) (acetylacetonate)$_2$. (auth)

Properties of Radioactive Materials

Refer also to abstracts 2746, 2841, 2892, 3759, 3841, and 3968.

3001 (ANL-8124) DECONTAMINATION OF PLUTONIUM-CONTAMINATED GLOVEBOXES. Januska, A. G.; Tyrrell, W. J.; Bennett, G. A. (Argonne National Lab., Ill. (USA)). Sep 1974. Contract W-31-109-eng-38. 9p. Dep. NTIS $4.00.

In connection with the Argonne National Laboratory efforts to reduce potential hazards in the event a plutonium use facility is hit by a tornado, a decontamination experiment was carried out to establish the lowest practicable limits of loose contamination in an operating glovebox, and to determine the relative merits of solvent wiping and vacuum cleaning as methods of decontamination. The results showed that a single wiping of the heavily contaminated test glovebox with Calgon Hel-Cat, Myco Tiara, or Pennwalt 2187 solvent for a short period of time removes > 95% of the loose contamination originally present, with a resultant contamination level of 10^6–10^7 dpm/100 cm^2. Subsequent wipings had little effect on removing the remaining (< 5%) contamination. Vacuum cleaning was ineffective as the sole decontamination method; however, this cleaning method is recommended for removing loose plutonium in crevices and other hard-to-wipe areas. These results, although limited by the narrow scope of the experiment, offer the possibility of decreased decontamination costs for gloveboxes compared to the standard technique, which requires successive wipings until the smears are essentially clean. (auth)

3002 (CEA-R-4574) CONTRIBUTION ON DISPROPORTIONATION STUDIES OF PENTAVALENT NEPTUNIUM IN ACIDIC SOLUTION. Escure, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Oct 1974. 100p. (In French). Dep. NTIS (US Sales Only) $8.00.

Thesis. Presented to Paris Univ. (France).

Disproportionation of neptunium(V) in nitric and perchloric acid solutions is studied by spectrophotometric measurements. It is shown that disproportionation is observed without nitrous acid only in nitric solutions. The complex formation of neptunium(IV) and (VI) with the nitrate is studied by spectrophotometry. The equilibrium constant of the reaction $2\ \mathrm{Np^V} \rightleftharpoons \mathrm{Np^{IV}}$ is higher in nitric than in perchloric acid solution. The difference between the two constants decreases as acidity increases. Correcting these constants from water and acid activity values it is shown that equilibrium displacement increases as complexation with nitrate increases. Disproportionation rates are measured in nitric and perchloric acid solutions ($I = 7$). They can be expressed in the form $R = k\,[\mathrm{Np^V}]^2\,[\mathrm{HX}]^n$ $n \geq 1.96$. The effects of ionic strength, nitrate concentration, and cation nature are measured. Apparent activation energies are given. Relationships of the disproportionation reaction in nitric and perchloric acid solutions to similar reaction occurring in sulfate and oxalate media are discussed. (auth)

3003 (HW-10475C(Del.)) HANFORD TECHNICAL MANUAL SECTION C. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 1 May 1944. 647p. Dep. NTIS $32.50.

Declassified 13 Jun 1974.

The purpose of the Hanford Separations Plant is to effect the separation of plutonium from the uranium metal and to prepare a concentrated relatively pure solution of plutonium nitrate as the final product. Section C discusses the chemistry of the separations process, describes the buildings and equipment provided for carrying out the various steps in the operation, and presents the detailed operating procedures used. (LK)

3004 (JUL-1080-NC) PREPARATION AND PROPERTIES OF THE ACTINIDE (IV) FORMATES OF Th, Pa, U, and Np. Bohres, E. W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Nuklearchemie). June 1974. 81p. (In German). Dep. NTIS (US Sales Only) $7.25.

Thesis. Submitted to Koeln Univ., (F. R. Germany).

The formates of Th, Pa, U, and Np were prepared by reaction of the chlorides with water-free formic acid. The compounds obtained were analyzed for carbon and hydrogen content, actinide metal content, and water of crystallization. The crystal structure, infrared spectra, magnetic susceptibility, and electron spectra were measured for each of the formates and the results given in tabular and graphic form. (JSR)

3005 (NBS-MISC.PUBL.-260-9) STANDARD REFERENCE MATERIALS: HALF LIVES OF MATERIALS USED IN THE PREPARATION OF STANDARD REFERENCE MATERIALS OF NINETEEN RADIOACTIVE NUCLIDES ISSUED BY THE NATIONAL BUREAU OF STANDARDS. Final Report. Anspach, S. C.; Cavallo, L. M.; Garfinkel, S. B.; Hutchinson, J. M. R.; Smith, C. N. (National Bureau of Standards, Washington, D. C. (USA)). 15 Nov 1965. 17p. (COM-74-11065). NTIS $4.00.

Values are given for the half lives of materials used in the preparation of standard samples of ^{22}Na, ^{45}Ca, ^{46}Sc, ^{54}Mn, ^{57}Co, ^{60}Co, ^{65}Zn, ^{85}Kr, ^{85}Sr, ^{89}Sr, ^{90}Sr, ^{88}Y, ^{95}Nb, ^{125}I, ^{139}Ce, ^{141}Ce, ^{147}Pm, ^{203}Hg, and ^{204}Tl, issued by the National Bureau of Standards. Instrumentation, source preparation, and the determination of impurities are also discussed. (GRA)

3006 (PTB-FMRB-50) STUDIES OF THE ACTIVITY RELEASE OF TRITIATED LUMINESCENT PIGMENTS. Guenther, E. (Physikalisch-Technische Bundesanstalt, Braunschweig (F. R. Germany). Forschungs- und Messreaktor). Aug 1973. 25p. (In German).

Four different luminescent tritium pigments of German and Swiss provenance were studied to get information on their tritium release to water and air. The experimental parameters, such as flow velocity, air humidity, and temperature, were varied. More than 99% of the T-losses have been in the form of water, independent of whether the test samples have been perfused by wet or dry air. Three of the four samples showed a largely similar behaviour. For the case of perfusion with dry air, a medium T-release rate of 0.07%/d has been observed, which—taking into account the tritium decay half-life of 12.346 yrs—allowed the effective half-life of the tritium activity in the luminescent pigment to be determined to be 2.2 years. Furthermore, a mechanism of the radiolysis of polystyrene is proposed, which in tritiated form is the energy donor in some luminescent pigments. The damage of this material may well be the reason for an increase in tritium release. (GE)

3007 BIS(CYCLOOCTATETRAENYL)NEPTUNIUM(III) AND -PLUTONIUM(III) COMPOUNDS. Karraker, D. G.; Stone, J. A. (Savannah River Lab., Aiken, SC). Contract AT(07-2)-1. J. Amer. Chem. Soc.; 96: No. 22, 6885-6888(30 Oct 1974).

From 166th national meeting of the American Chemical Society; Chicago, IL (26 Aug 1973).

Potassium bis(cyclooctatetraenyl)neptunium(III) (KNp(COT)$_2$, COT = $C_8H_8^{2-}$) and KPu(COT)$_2$ were prepared as bis(tetrahydrofuran) (THF) solvates by treating the trivalent actinide bromides or iodides with K$_2$COT in THF solution. X-ray powder patterns indicate that these compounds are isostructural, and the similarity of the powder patterns of KPu(COT)$_2$ · (CH$_3$OCH$_2$)$_2$O with the Ce^{3+} analog suggests that the Pu^{3+} ion is in a D_{8d} ("sandwich") site in the molecule. The Mössbauer spectrum of the Np(III) compound has an isomer shift (δ) of +3.92 cm/sec, which confirms a +3 valence with only slight covalency, and a quadrupole splitting constant (eqQ/4) of 0.72 cm/sec with zero asymmetry. Magnetic susceptibility measurements on both compounds are reported and discussed in terms of crystal field models. (auth)

3008 KINETIC STUDY OF THE REDUCTION OF AMERICIUM(VI) BY NEPTUNIUM(V). Woods, M.; Sullivan, J. C. (Argonne National Lab., IL). Inorg. Chem.; 13: No. 11, 2774-2775(Nov 1974).

Results of a kinetic study of the reaction Am(VI) + Np(V) → Am(V) + Np(VI) are reported. It is demonstrated that the reaction goes to completion as written. There is no evidence for a kinetic path dependent upon hydrogen ion concentration. The variation of the rate parameter as a function of temperature is tabulated. (JGB)

3009 STABILITY CONSTANTS OF CHELATES OF VO(II), UO_2(II), Hg(II), AND Cd(II) WITH 1-HYDROXY-2-NITROSONAPHTHALENE-4-SULFONIC ACID. Lingaiah, P.; Sundaram, E. V. (Postgraduate Center, Warangal, India). Indian J. Chem.; 12: No. 5, 539-540(May 1974).

Stability constants of 1 : 1 chelates of 1-hydroxy-2-nitrosonaphthalene-4-sulfonic acid with VO(II), UO_2(II) and Cd(II) have been determined spectrophotometrically and potentiometrically. Stability constants of VO(II) and UO_2(II) chelates have also been determined at 35° and at $\mu = 0.1M$ (KNO_3 (in 20 and 40% (v/v) methanol-water, ethanol-water and isopropanol-water mixtures to study the effect of dielectric constant of the medium on the stability constant and the latter was found to increase with decrease in the former. The stabilities of metal chelates decrease in the order VO(II) > UO_2(II) > Hg(II) >Cd(II). (auth)

3010 RE-EVALUATION OF THE STABILITY CONSTANTS OF Np(V) AND Np(VI) CHLORIDE COMPLEXES. Danesi, P. R.; Chiarizia, R.; Scibona, G.; D'Alessandro, G. (Comitato Nazionale per l'Energia Nucleare, Casaccia, Italy). J. Inorg. Nucl. Chem.; 36: No. 10, 2396(Oct 1974).

In previous work (Danesi et al., J. Inorg. Nucl. Chem.; 33:3503 (1971)) the complex formation constants between NpO_2^+ and Cl^- ions were evaluated potentiometrically. A later publication (Ferri, Acta Chem. Scand.; 26(2): 21(1972)) showed, for similar experimental conditions, that one assumption that had been made might not be justified. Further work was therefore undertaken, and the results are discussed. (UK)

3011 QUENCHING OF THE URANYL (UO_2^{2+}) EMISSION BY INORGANIC IONS IN SOLUTION. Matsushima, R.; Fujimori, H.; Sakuraba, S. (Shizuoka Univ., Hamamatsu, Japan). J. Chem. Soc., Faraday Trans., I; 70: No. 9, 1702-1709(1974).

Quenching constants (K) of various inorganic ions were measured for the quenching of the uranyl emission in aqueous acid solution at room temperature. Quenching constants of halogen or halogen-like anions (X^-) increase with decrease in their oxidation potentials and a plot of log K against the oxidation potential is linear, suggesting a chemical (redox) quenching process. Static quenching via formation of a non-emissive complex in the ground state is unlikely to be important. Quenching by some metal ions, when the process is favoured by both the spin conservation rule and the exothermicity of the process, is accompanied by sensitized reactions indicating involvement of an electronic energy transfer process. Efficient quenching by many metal cations occurs without chemical changes even when the electronic energy transfer process is forbidden. There is no correlation between the quenching constants and the magnetic moments or atomic weights of the quenchers. There is a correlation between the quenching constants for the cations and their oxidation potentials and a mechanism of physical quenching through weak electron donor-acceptor interactions is suggested. (auth)

3012 DICESIUM TETRACHLOROOXOURANIUM(IV): AN OXOHALO COMPLEX OF URANIUM(IV). Watt, G. W.; Baugh, D. W.; Gadd, K. F. (Univ. of Texas, Austin). Inorg. Nucl. Chem. Lett.; 10: No. 11, 987-989(Nov 1974).

The preparation of dicesium tetrachlorooxouranium(IV) by the method described previously (Watt et al., Inorg. Chem.; 8:2252 (1969)) is reported. The complex was characterized by chemical analysis, infrared spectroscopy, and x-ray diffraction. (UK)

3013 REACTIONS OF BIS(TETRAETHYLAMMONIUM) HEXAHALO COMPLEXES OF URANIUM(IV) AND THORIUM(IV) WITH LIQUID AMMONIA. Watt, G. W.; Baugh, D. W. (Univ. of Texas, Austin). Inorg. Nucl. Chem. Lett.; 10: No. 11, 1025-1029 (Nov 1974).

Previous studies of the reaction of bis(tetraethylammonium)-tetrabromodioxouranium(VI) with liquid ammonia prompted an investigation of the reactions of related salts of uranium(IV) and thorium(IV). Experimental methods were as described previously (Watt et al., Inorg. Chem.; 8:2252(1969)). The results indicate the existence of a new class of highly reactive compounds: diammonium diamidotetrahalo actinides. A preliminary account is presented of the chemical reactions of the new compounds, and of their infrared spectra and x-ray spectra. (UK)

3014 SIMULTANEOUS DETERMINATION OF THE FORMATION CONSTANTS OF THE CITRATO COMPLEXES OF AMERICIUM, CURIUM, CALIFORNIUM, EINSTEINIUM, AND FERMIUM. Hubert, S.; Hussonnois, M.; Brillard, L.; Goby, G.; Guillaumont, R. (Paris Univ., Orsay, France). J. Inorg. Nucl. Chem.; 36: No. 10, 2361-2366(Oct 1974). (In French).

Formation constants for $MHCitCit^{2-}$ and $MCit_2^{3-}$ (M - Am, Cm, Cf, Es, Fm) complexes were measured simultaneously by solvent extraction of the chelates. Variations of such constants vs Z show the third part of the 5f tetrad. (auth)

3015 URANATES(VI) AND TUNGSTATES(VI) WITHIN THE SYSTEM $Li_2O–UO_3–WO_3$. Hauck, J. (Kernforschungsanlage, Juelich, Ger.). J. Inorg. Nucl. Chem.; 36: No. 10, 2291-2298 (Oct 1974).

The system $Li_2O-UO_3-WO_3$, which was investigated between 300 and 1600°C at 1 atm O_2, contains the compounds $Li_6WO_6-Li_6UO_6$, $Li_4WO_5–Li_4UO_5$, $Li_2WO_4–Li_2UO_4$, $Li_2W_2O_7$, $Li_2W_4O_{13}$, $LiU_{0.83}O_3$, $Li_2U_3O_{10}$, $Li_2U_6O_{19}$, UWO_6, and UW_3O_{12}. Lithium uranates(VI) and tungstates(VI) with high Li_2O content show an octahedral coordination of uranium and tungsten in closely related crystal structures and can form some solid solutions. At low Li_2O content uranium forms strong uranyl bonds whereas tungsten prefers tetrahedral coordination with very little solid solution of uranium. (auth)

3016 KINETICS OF THE U(VI) – U(IV) EXCHANGE IN PERCHLORATE AND SULPHATE MEDIA. Ekstrom, A.; Batley, G. E.; Florence, T. M.; Farrar, Y. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Inorg. Nucl. Chem.; 36: No. 10, 2355-2359(Oct 1974).

Kinetics of the U(VI)–U(IV) isotope exchange reaction were studied in perchlorate and sulphate media using uranium-233 as a tracer. At constant acid concentration the rate of exchange was enhanced by the addition of sulphate. With increasing sulphuric acid concentration the rate of exchange at first decreased, but then increased again as the sulphuric acid concentration increased beyond 1 M. Reaction mechanisms consistent with the observed results are discussed. (auth)

3017 COMPLEX OF NONA-COORDINATE U(IV): $(Ph_4As)_2$ $[U(pyridine\text{-}2,6\text{-}dicarbcxylato)_3]\cdot 3H_2O$. Baracco, L.; Bombieri, G.; Degetto, S.; Forsellini, E.; Graziani, R.; Marangoni, G. (Consiglio Nazionale delle Ricerche, Padua). Inorg. Nucl. Chem. Lett.; 10: No. 11, 1045-1050(Nov 1974).

The preparation, characterization, and crystal structure of a salt-like complex, $(PhAs)_2$ $[U(PDC)_3]\cdot 3H_2O$, in which uranium is nona-coordinate is reported. The compound was obtained by addition of UCl_4 to an excess of H_2PDC (= pyridine-2,6-dicarboxylic acid) and Ph_4AsCl in aqueous solution. Results of visible absorption spectroscopy, infrared spectroscopy and x-ray diffraction are given and discussed, and a structure is proposed. (UK)

3018 ABSORPTION SPECTROPHOTOMETRIC STUDY OF THE EQUILIBRIUM $PU^{4+} + Cl^-$ REVERSIBLE $PU^{3+} + 1/2Cl_2$ IN FUSED LiCl–CsCl·(55 to 45 mol. %). Landresse, G.; Duyckaerts, G. (Univ., Liege). Inorg. Nucl. Chem. Lett.; 10: No. 11, 1051-1057(Nov 1974). (In French).

From a quantitative study of the equilibrium $Pu^{4+} + Cl^- \rightleftharpoons Pu^{3+} + 1/2\ Cl_2$ in the mixture LiCl-CsCl (55 to 45 mole %) at 400, 450, 500 and 550°C by absorption spectrophotometry in the visible and near infrared range, it was possible to calculate the equilibrium constant of the reaction. From this the thermodynamic quantities were deduced: $\Delta H = 59 \pm 15$ kJ mole^{-1} and $\Delta S = 61 \pm 20$ J mole^{-1}K^{-1}. The normal potential of the couple Pu^{4+}/Pu^{3+} ($E^0_{Pu^{4+}/Pu^{3+}} - E^0_{Cl_2/Cl^-} = -0.160 \pm 0.007$ V at 450°C). (auth)

3019 ABSORPTION SPECTROPHOTOMETRIC STUDY OF THE EQUILIBRIUM $PuO_2^{2+} + Cl^-$ REVERSIBLE $PuO_2^+ + 1/2\ Cl_2$ IN FUSED LiCl–CsCl (55 TO 45 MOL. %). Landresse, G.; Duyckaerts, G. (Univ., Liege). Inorg. Nucl. Chem. Lett.; 10: No. 11, 1059-1068(Nov 1974). (In French).

From a quantitative study of the equilibrium $PuO_2^{2+} + Cl^- \rightleftharpoons PuO_2^+ + 1/2\ Cl_2$ in the mixture LiCl–CsCl (55 to 45 mole %) at 400, 450, 500 and 550°C by absorption spectrophotometry in the visible and near infrared range, it was possible to calculate the equilibrium constant of the reaction. From this the thermodynamic quantities were deduced: $\Delta H = 29.7 \pm 2.5$ kJ mole^{-1} and $\Delta S = 24.0 \pm 3.4$ J mole^{-1}K^{-1}. The normal potential of the couple PuO_2^{2+}/PuO_2^+ ($E^0_{PuO_2^{2+}/PuO_2^+} - E^0_{Cl_2/Cl^-} = -0.126 \pm 0.007$ V at 450°C). (auth)

3020 EFFECT OF PRESSURE ON LIQUID-LIQUID IMMISCIBILITY OF HIGH TEMPERATURE AQUEOUS SOLUTION MIXTURES OF URANYL SULFATE AND SULFURIC ACID, 280 TO 4500 C, 75 TO 1800 BARS. Marshall, W. L.; Gill, J. S. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem.; 36: No. 10, 2303-2312(Oct 1974).

With rising temperature, aqueous uranyl sulfate and uranyl sulfate–sulfuric acid solutions are very unusual in forming two liquid phases at temperatures above 285°C. In this study the temperatures of immiscibility are shown to be raised by as much as 135°C through the application of hydrostatic pressures up to 1800 bars. This range of pressure extended by a factor of six that of an earlier investigation. An optical cell for use to 500°C and 2000 bars is described, and allowed visual determination of the appearances of immiscibility. The rise in temperature of two liquid phase appearance with increase in hydrostatic pressure was found to be 0.075°C/bar near 300°C, where the initial condition is the boundary of immiscibility in equilibrium with vapor. On addition of sulfuric acid the temperature of appearance of immiscibility at vapor saturation is raised, and at these higher initial temperatures the increase in temperature of immiscibility with increase in hydrostatic pressure rises to a value near 0.12°C/bar at 360°C. The present results further confirm a straight line relationship of temperature of immiscibility vs pressure, and support the earlier suggestion of an approximate correlation of the slope with the change in temperature with hydrostatic pressure for pure water either at constant density or constant product of dielectric constant times absolute temperature. (auth)

3021 INFRARED AND RAMAN SPECTRA OF TETRACHLORO- AND TETRABROMODIOXOURANIUM(IV) COMPLEXES. Marzotto, A. (Consiglio Nazionale delle Ricerche, Padua). Inorg. Nucl. Chem. Lett.; 10: No. 10, 915-923(Oct 1974).

In previous papers the preparation and properties of ionic complexes obtained by reaction of uranyl halides with the corresponding halides of substituted ammonium derivatives cations were reported. The structure of these compounds was shown to be $L_2UO_2X_4$ (L = thiamine, acetylcholine; X = Cl^-, Br^-) on the basis of physicochemical measurements culminating in the x-ray structure determination for $[TH]_2UO_2Cl_4$ and $[AcCh]_2UO_2Br_4$. Since there are uncertainties and conflicts over the assignment of ir and Raman vibrational frequencies in the $[UO_2X_4]^{2-}$ anion an attempt to compare the spectral features of the $[UO_2Cl_4]^{2-}$ and $[UO_2Br_4]^{2-}$ anions having an identical cation was undertaken. Moreover in order to investigate the role of the organic cation on the same $[UO_2X_4]^{2-}$ anion either choline or its acetyl-derivative was used as cation and their characteristics compared. The electronic, ir, Raman and ^1H NMR spectra of bis(choline) tetrachloro- and tetrabromodioxouranium (VI) are reported in comparison with those found for the same anionic complexes of acetylcholine. (auth)

3022 THERMAL DECOMPOSITION OF BETA URANYL DIHYDROXIDE SINGLE CRYSTALS. Bannister, M. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Inorg. Nucl. Chem.; 36: No. 9, 1991-1998(Sep 1974).

Thermal decomposition of beta uranyl dihydroxide single crystals was investigated using optical microscopy and x-ray diffraction. The crystals decomposed first to a mixture of α -UO_3 and δ -UO_3, these products nucleating at crystal surfaces. Both UO_3 phases transformed at higher temperatures to $UO_{2.9}$ and then U_3O_8. Although the various products showed preferred orientation, the layers in the parent $UO_2(OH)_2$ were fragmented during dehydration forming porosity which was gradually reduced by sintering at higher temperatures. Isothermal dehydration at 300 to 400°C obeyed classical decomposition theory, with constant dehydration rates within the {001} layer plane and a dependence of reaction rate on direction which could be understood from the crystal structure. (auth)

3023 EQUATORIAL PENTA COORDINATION IN URANYL COMPLEXES WITH N-ETHYLENEDIMETHYLAMINESALICYLALDIMINE. Clemente, D. A. (Consiglio Nazionale delle Ricerche, Padua); Bandoli, G.; Benetollo, F.; Vigato, P. A.; Casellato, U. J. Inorg. Nucl. Chem.; 36: No. 9, 1999-2013(Sep 1974).

The crystal and molecular structure of bis(N-ethylenedimethylaminesalicylaldiminato) dioxouranium(VI), $C_{22}H_{30}N_4O_4U$, was determined by three-dimensional x-ray methods. The crystals are triclinic, space group $P\bar{1}$ with cell dimensions a = 10.501 [8], b = 11.250 [8], c = 10.729 [11] Å, α = 103.97 [9], β = 99.17 [16], γ = 99.70 [8]°; D_m = 1.82, Z = 2, D_c = 1.83 g cm^{-3}. The structure was solved by the conventional heavy-atom method from 2973 reflections collected by counter, and refined by least-squares method to a conventional R factor of 0.034. Each uranium atom is in a pentagonal-bipyramidal environment; the coordination plane is comprised of the two oxygen and three nitrogen atoms of two potentially tridentate Schiff bases with the uranyl group perpendicular to this plane. The U-O apical distances are both 1.78 [1] Å and the equatorial 2.24 [1] Å; the U-N distances are 2.57 [1], 2.59 [1] and 2.69 [1] Å, in accordance with the two different electronic situations at the nitrogen atoms. The complex exhibits an overall "stepped" geometry with the $-CH_2-CH_2-$carbon atoms out from the equatorial plane by 0.27 and −0.54 Å. (auth)

3024 PREPARATION, CRYSTAL STRUCTURES, AND SOME PROPERTIES OF CALIFORNIUM OXYSULFATE AND OXYSULFIDE. Baybarz, R. D.; Fahey, J. A.; Haire, R. G. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem.; 36: No. 9, 2023-2027 (Sep 1974).

Californium oxysulfate ($Cf_2O_2SO_4$) was prepared by calcination of Cf(III)-loaded Dowex resin beads or hydrated $Cf_2(SO_4)_3$ in air at 700 to 800°C. At temperatures above 860°C, the oxysulfate decomposed to the sesquioxide. Calcination of the hydrated californium sulfate or the californium oxysulfate salt in atmospheres containing hydrogen, or in vacuum, at 800°C produced the oxysulfide (Cf_2O_2S). It was observed that the californium oxysulfide could be reoxidized to the oxysulfate by reheating the former product in air at 800°C. The decomposition of the oxysulfate and the oxysulfide to the sesquioxide by heating in air was found to be dependent on both the duration and the temperature of the calcination process. Examination of oxysulfate samples stored at ambient temperatures as a function of time showed that self-irradiation initially causes a loss in crystallinity and subsequently a partial decomposition to the sesquioxide. Lattice parameters for the oxysulfate and oxysulfide were derived from X-ray data. The lattice constants for the orthorhombic oxysulfate are a_o = 4.187 ± 0.002 Å, b_o = 4.072 ± 0.002 Å and c_o = 13.009 ± 0.006 Å. The cell dimensions for the trigonal oxysulfide are: a_o = 3.844 ± 0.002 Å and c_o = 6.656 ± 0.004 Å. (auth)

3025 PRODUCTION OF PROTEINS AND PEPTIDES LABELLED WITH RADIOAMINO ACID IN THE PROTEIN-AMINO ACID SYSTEM. Zaidenberg, M. A.; Korotkina, R. N.; Konikov, A. S. (Academy of Medical Science, Moscow). Int. J. Appl. Radiat. Isotop.; 25: No. 8, 333-336(Aug 1974).

A method of labelling of biologically active peptide Contrical with ^{14}C-lysine is presented. Peptide labelling was performed at neutral pH and a temperature of 37°C. To eliminate free radioactive amino acid, gel filtration on Sephadex G-15 was used. The resulting preparation of radioactive Contrical had a specific activity of the order of 0.25 μCi/mg and fully retained the biological activity of the unlabelled native preparation. (auth)

3026 PREPARATION OF SOLID REAGENTS WITH HOMOGENEOUS DISTRIBUTION OF RADIONUCLIDE LABELS. Jesenak, V. (Slovak Technical Univ., Bratislava); Tolgyessy, J.; Klehr, E. H. Radiochem. Radioanal. Lett.; 19: No. 3, 223-226(25 Oct 1974).

A method is described for the preparation of solid reagents with an operationally homogeneous distribution of radioactive tracers. Powdered material is labeled by diffusion or bombardment, after which the powder is pressed into tablets of desired size and shape. Kryptonated silver nitrate, potassium chloride, and ammonium nitrate were prepared in this way. (auth)

3027 PHOTOMETRIC INVESTIGATION OF SYSTEMS OF TWO COMPLEXES WITH POLYDENTATE LIGANDS. Budesinsky, B. W. (Phelps Dodge Corp., Morenci, AZ). Anal. Chim. Acta; 71: No. 2, 333-342(Aug 1974).

A general approach to the determination of the composition and stability of a side complex $M_pH_hL_q$, if the data for the main complex $M_mH_jL_n$ are known, was developed. Two cases and two experimental methods should be differentiated: (a) $p(n-1) \neq m(q-1)$, dilution method; (b) $n \neq q$, constant concentration method. The case (a) was demonstrated on the uranyl–xylenol orange system (log β_{121} = 29.80 ± 0.05, log β_{142} = 56.60 ± 0.10), and case (b) on the lanthanum–8–quinolinol system (log β_{103} = 21.89 ± 0.10, log β_{102} = 14.62 ± 0.02 in aqueous 50% ethanol); β_{mjn} and β_{phq} are the overall stability constants of the corresponding complexes measured at the ionic strength 0.1 M and 25 ± 1 °C. (NL)

3028 IMPROVED METHOD FOR THE SYNTHESIS OF ^{14}C-LABELLED OR ^3H-LABELLED N-ACETYLNEURAMINIC ACID. Schauer, R.; Buscher, H. P. (Univ., Bochum, Ger.). Biochim. Biophys. Acta; 338: No. 2, 369-373(28 Feb 1974).

Neuraminic acid-beta-methylglycoside was prepared from the products obtained by methanolysis of edible bird nest substance (yield, 80%). The methylglycoside was converted to the corresponding methylester hydrochloride by methanol-HCl treatment and crystallized from dioxan-light petroleum (yield, 50%). Its properties including mass spectrometry are described. A simple procedure for synthesis of N-[1-^{14}C]-acetylneuraminic acid and N-[^3H]acetylneuraminic acid (yields, 75-85%) with high specific radioactivities from the methylester from neuraminic acid-beta-methylglycoside and 1-^{14}C- or ^3H-labelled acetic anhydride in absolute methanol is described. By this acetylation in water-free solution up to 85% of the theoretically expected amount of radioactivity was found in the N-acetyl groups of neuraminic acid. (NL)

3029 SPECTRAL-LUMINESCENT STUDY OF CRYSTALS OF URANYL COMPOUNDS. Volodko, L. V.; Komyak, A. I.; Sevchenko, A. N.; Umreiko, D. S. (Belorussian State Univ., Minsk). J. Lumin.; 8: No. 3, 198-202(Jan 1974).

The luminescence spectra of uranyl nitrate and chloride crystals were investigated at low temperature. From the polarization of the fine structure, vibrational analysis was made. Splitting of lines at 4°K are in accordance with the Davydov theory. Kinetic measurements are also utilized in identifying the electronic transitions. (NL)

3030 BISULFITE-CATALYZED TRITIUM LABELLING OF DNA AND RNA. Iida, S.; Wataya, Y.; Kudo, I.; Kai, K.; Hayatsu, H. (Tokyo Univ.). FEBS (Fed. Eur. Biochem. Soc.) Lett.; 39: No. 3, 263-266(1 Mar 1974).

Results of ammonium bisulphite-catalyzed tritium labelling of calf thymus DNA and yeast RNA at 37°C and pH 7.5 are reported. These conditions were suitable to bring about H → ^{3}H exchange at position 5 of both cytosine and uracil without concomitant deamination of cytosine. After replacing easily exchangeable ^{3}H by H the labelled nucleic acids were analyzed for radioactivity. Cytosine in denatured DNA and RNA was labelled by catalysis of bisulphite. Little incorporation was obtained for cytosine residues in native DNA. Uracil in DNA was labelled effectively whereas thymine in DNA, possessing a CH_3 instead of H at position 5, was not. Deamination of cytosine residues did not occur during the bisulphite treatment. Nucleic acids can be labelled by the bisulphite method with little damage during the treatment. (NL)

3031 REVISED METHOD FOR THE TRITIUM LABELLING OF PYRRIDOXAL-5′-PHOSPHATE. Raibaud, O.; Goldberg, M. E. (Institut Pasteur, Paris). FEBS (Fed. Eur. Biochem. Soc.) Lett.; 40: No. 1, 41-44(15 Mar 1974).

In a three-step method, involving the reduction of pyridoxine-5′-phosphate with ^{3}H-labelled sodium borohydride, the oxidation of the pyridoxine-5′-phosphate (PLP) thus obtained with manganese dioxide, and the separation of the products by chromatography on an ion-exchange resin, it unexpectedly appeared to be unable to recover radioactive PLP. As a result of a further study of this separation step it was unexpectedly found that ^{3}H-labelled PLP can be readily separated from the unlabelled molecule by ion-exchange chromatography. The ion-exchange and thin-layer chromatographic methods are described. The material contained in the second chromatographic radioactivity peak was identified by three types of experiments, i.e. thin-layer chromatography, reduction of the radioactive material and the interaction between the radioactive material and apo-tryptophanase. More than 99% of the PLP molecules was bound to the apo-enzyme and from this it was concluded that more than 90% of the tritium atoms present in the second radioactivity peak were incorporated in PLP molecules. (NL)

3032 ^{35}S LABELING OF THIOUREA DERIVATIVES BY ISOTOPE EXCHANGE REACTION. Sao, T. (Miyagi Univ. of Education, Sendai). Radioisotopes (Tokyo); 23: No. 3, 145-148 (Mar 1974).

The exchange reactions of thiourea derivatives having $-NH-C=S$ group with sodium hydrosulfide-^{35}S or with elementary sulfur-^{35}S were investigated. In all systems the exchange reaction occurred under the more drastic condition than that on dithiocarbamates. Thiol form as tautomer of these thiourea derivatives appeared to inhibit the exchange reaction. ^{35}S-labeled thiourea derivatives were isolated from the reaction mixtures. (auth)

3033 LIGHT-INDUCED TRITIATION OF AROMATIC COMPOUNDS WITH PROPANETHIOL [S^{3}H]. Takiguchi, H.; Yoshida, K. G.; Ouchi, H.; Yoshida, M.; Morikawa, N. (Tokyo Univ.). Chem. Lett. (Tokyo); No. 6, 593-594(Jun 1974).

The aromatic tritiation induced by irradiation of mixtures of aromatic compounds and propanethiol[S^{3}H] was studied with respect to the tritium distribution in the nucleus and the relative rate of tritiation. A mechanism involving a reaction of an excited aromatic molecule with the thiol is proposed. (auth)

3034 NEW POSSIBILITIES OF PREPARATIVE SYNTHESIS OF RADIOACTIVE NUCLEOTIDES. Enzyme Synthesis of Tritium Labelled Uridine 5′-Triphosphate in High Yield. Filip, J. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague); Bohacek, L.; Vesely, J.; Cihak, A. J. Label. Compounds; 10: No. 3, 489-497(1974).

Growth of Escherichia coli B in the presence of sub-bacteriostatic concentration of various compounds results in the enhancement of activity of enzymes catalyzing the transformation of uridine to its 5′-phosphates. Partially purified extracts of E. coli cultivated in the presence of 1×10^{-5} M 5-azacytidine were applied for the preparative synthesis of tritium-labeled uridine 5′-triphosphate. Yield of the newly formed nucleotide was about 90% and was higher during the short-term incubation using enzyme extract from the treated cells than that from controls. (auth)

3035 SPECTROSCOPIC STUDIES ON THE URANYL COMPLEXES WITH 1,2-DISUBSTITUTED BENZENES. Kim, B. I.; Miyake, C.; Imoto, S. (Osaka Univ.). J. Inorg. Nucl. Chem.; 36: No. 9, 2015-2021(Sep 1974).

Uranyl complexes with a series of 1,2-disubstituted benzenes, such as phthalic acid (H_2ph), salicylic acid (Hsal), pyrocatechol (H_2pc), anthranilic acid (Hant), o-aminophenol (amph), and o-phenylenediamine (phen), were prepared and studied by ir, electronic, and NMR spectroscopy. Characteristic ir stretching frequencies (4000 to 200 cm^{-1}) are reported for each complex. One or two new strong bands are observed in the region of 340 to 500 nm in all the complexes except uranyl phthalate, which are considered to be due to the charge transfer transition from the pπ orbital of the donor atoms to 5f- and/or 6d-orbitals of uranium. Characteristic proton magnetic resonance spectra of the complexes are also reported and discussed in relation to the magnetic anisotropy of the uranyl ion and to the drainage of electron density from the donor atom to the metal. (auth)

3036 SYNTHESIS, ISOLATION, AND IMMUNOCHEMICAL CHARACTERIZATION OF N-(CARBOXYMETHYL-^{3}H)-D-LYSERGAMIDE. Winkelhake, J. L.; Voss, E. W. Jr. (Univ. of Illinois, Urbana). J. Label. Compounds; 10: No. 3, 475-488(1974).

Covalent amide linkage of glycine-2-^{3}H to the non-hallucinogenic derivative, d-lysergic acid (LSA), by carbodiimide activation results in a lysergic acid analog which has potential use in biochemical studies of the mode of action, metabolism, and immunology of d-lysergic acid diethylamide (LSD). Optimal conditions for the reaction and isolation of the product, N-(carboxymethyl-^{3}H)-d-lysergamide, were determined. The product was analyzed by radioimmunoassay and by equilibrium dialysis with highly specific antibody to the lysergyl moiety. (auth)

3037 EQUATION OF STATE OF UF_6 FOR DENSITIES UP TO 0.01180 G/CM^3 AND TEMPERATURES UP TO 367°K. Malyshev, V. V. Sov. At. Energy (Engl. Transl.); 34: No. 1, 55-56(Jan 1973).

Translated from At. Energ. (USSR); 34: No. 1, 42-44(Jan 1973).

Pressures up to 750 mm Hg were also considered, as well as the determination of the saturated vapor density of UF_6 and the heats of sublimation at 296.3 to 327.6°K. The equation takes the form: $p\mu/\rho RT = 1 + (3.94 - 2.197 \cdot 10^3/T)\rho$. The mean deviation between the experimental data and those calculated from the equation never exceeds 0.20 to 0.3% over the whole range of parameters of state studied. (JGB)

Radioactive Waste Treatment

Refer also to abstracts 3333, 3376, and 4016.

3038 (AERE-R-7742) DIAZOMETHANE AS AN IODINE TRANSPORT AGENT. Sharpe, B. P. K. (UKAEA Research Group, Harwell, Atomic Energy Research Establishment). Jul 1974. 24p. Dep. NTIS (US Sales Only) $4.25. UK 50 pence.

Diazomethane has been tested as a means of overcoming the problems of iodine absorption from the gas phase on to different parts of the apparatus used. It converts I_2 and HI to much less absorbable forms, viz. CH_2I_2 and CH_3I respectively. Experiments with ^{125}I as tracer demonstrated that diazomethane is very effective in preventing absorption on glass and metal surfaces, provided the tracer is exposed to the reagent in the gas phase before absorption can occur. It is less effective in removing iodine already absorbed. Appreciable absorption occurs on araldite and PTFE even in presence of diazomethane, and they should be excluded from exposed parts of the apparatus. It was also shown that whereas $^{125}I_2$ is strongly absorbed by Amberlite XAD-4 (a macroreticular resin without functional groups) and by sodium zeolite (13X Molecular Sieve), the absorption is greatly reduced by diazomethane. Silver zeolite, 13X(Ag), on the other hand is a very efficient iodine trapping material under all conditions. Ethylene and hydrazine were found to be of little effect in transporting iodine, but were not fully tested. (auth)

3039 (ARH-SA-174) FIXATION OF RADIOACTIVE WASTE BY HYDROTHERMAL REACTIONS WITH CLAYS. Barney, G. S. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Jan 1974. Contract AT(45-1)-2130. 35p. (CONF-740346-2). Dep. NTIS $4.75.

From high level radioactive waste management symposium; Los Angeles, California, USA (31 Mar 1974).

A means of converting radioactive wastes to solid, relatively insoluble, aluminosilicate minerals is described. This process can be applied to caustic sodium wastes such as neutralized Purex wastes and sodium salts or oxides produced by evaporation or calcination of liquid wastes. Powdered aluminum silicate clays such as kaolin, bentonite, halloysite, or dickite are reacted with aqueous solutions or slurries of caustic waste at temperatures in the range of 30 to 100°C. The reaction produces a salt-filled, sodium aluminosilicate with radioactive isotopes trapped in the aluminosilicate framework structure. The mineral type is felspathoid and, for wastes which contain nitrate ion, the project has the framework structure of cancrinite. The stoichiometry of the reaction requires two moles of sodium hydroxide for each mole of cancrinite formed. Reactions of kaolin and bentonite with actual waste show that ^{137}Cs, ^{90}Sr, and ^{106}Ru are trapped in the cancrinite along with the sodium salts present. The clay appears to go through a gel phase, then partial dissolution, and, finally, precipitation of the cancrinite from solution. Electron photomicrographs show the product to be a mass of round clusters of cancrinite crystals approximately 0.5 μm in diameter. Leaching of the powdered product with distilled water at 30°C gives bulk leach rates in the range of 10^{-7} to 10^{-10} g sample/cm^2-day. (auth)

3040 (BNWL-1841) RESEARCH AND DEVELOPMENT ACTIVITIES WASTE FIXATION PROGRAM. Quarterly Progress Report, April–June 1974. McElroy, J. L. (comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1974. Contract AT(45-1)-1830. vp. Dep. NTIS $5.45.

Three runs were completed with the spray calciner and inconel melter. During run DSS-15, a 510-hour reliability run, 11,300 l of PW-4b waste was calcined and 2.4 metric tonnes of borosilicate glass was produced. Physical property data including viscosity, thermal expansion coefficient, electrical conductivity and elastic moduli were obtained for candidate waste glasses. The viscosity of glass made in the pilot plant spray calciner-melter was identical with that of glass prepared in the laboratory. Initial results of alpha radiolysis experiments indicate that the residual nitrate in calcined radioactive waste decomposes at a faster rate than the residual water. A study has begun to determine the long-term effects of alpha radiation on solidified high-level wastes using ^{244}Cm as the radiation source. Enough ^{244}Cm is being added to the synthetic waste to simulate 100 yr storage in a 1-yr test. The study is designed to observe changes in leach rates, stored energy, helium buildup effects, and physical properties. Preliminary stored energy measurements indicate less than 2 cal/g is released between 25 and 500°C after the equivalent of 15 years storage of a waste glass. As part of a fundamental study to gain insight into the best candidates for crystalline radioactive waste forms, selected phases are being synthesized or otherwise obtained. Leach tests indicate chemical durability is less dependent upon structure type of the phases than upon the chemical constituents contained in the structure. The risk analysis of a high-level waste management system from liquid storage at the reprocessor up to ultimate disposal is continuing. The analysis of a representative system has proceeded through subsystem definition, listing of failure events and construction of preliminary safety analysis trees for all subsystems. (LK)

3041 (BNWL-1843) STUDIES ON MANAGEMENT OF SELECTED WASTES. Quarterly Progress Report, April–June 1974. Schneider, K. J. (Battelle Pacific Northwest Labs., Richland Wash. (USA)). Jul 1974. Contract AT(45-1)-1830. 29p. Dep. NTIS $4.00.

Progress is reported in the areas of decontamination and densification of chop-leach cladding residues, waste treatment and handling processes, and tritium separation and fixation. (LK)

3042 (GERHTR-109) AKUT: A PROCESS FOR THE SEPARATION OF AEROSOLS, KRYPTON, AND TRITIUM FROM BURNER OFF-GAS IN HTR FUEL REPROCESSING. Laser, M.; Barnert-Wiemer, H.; Beaujean, H.; Merz, E.; Vygen, E. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Chemische Technologie). 1973. 19p. (CONF-740807-19). Dep. NTIS (US Sales Only) $4.00.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

Work performed under United States-German High Temperature Reactor Research Exchange Program.

The AKUT-process consists of the following process steps: aerosol retention by an electrostatic separator followed by HEPA filters, oxidation of CO with O_2 or reaction of excess O_2 with CO, respectively, compression, scrubbing and/or liquefaction, separation of krypton by distillation, and separation of tritiated water and iodine by adsorption or chemical reaction. Liquefied off-gas with low permanent gas content resulting from graphite burning with oxygen may be distilled at ambient temperature. Off-gas with higher permanent gas content from burning with oxygen enriched air must be processed at lower temperature. The ambient temperature flowsheet is preferable from economic as well as safety point of view. (auth)

3043 (HEDL-TME-74-50) COMMERCIAL ALPHA WASTE PROGRAM. Quarterly Progress Report, March–June 1974. Cooley, C. R. (Comp.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1974. Contract AT(45-1)-2170. 35p. Dep. NTIS $4.00.

This is the first Quarterly Progress Report on the Commercial Alpha Waste Program being conducted by Hanford Engineering Developmental Laboratory (HEDL) for the Division of Waste Management and Transportation, USAEC. Included in this report is a description of the program and discussion on the topics of fuel fabrication waste categorization and acid digestion process development. (auth)

3044 (ISO-100(Del.)(Vol.1)) WASTE MANAGEMENT TECHNICAL MANUAL. Volume 1. Buckingham, J. S. (ed.). (Isochem Inc., Richland, Wash. (USA)). 31 Aug 1967. Contract AT(45-1)-1851. 340p. Dep. NTIS $20.00.

Declassified 8 Apr 1974.

The Waste Management Technical Manual was prepared to provide a documented compendium of the technical bases and general physical features of Isochem Incorporated's Waste Management Program. Volume 1 contains the Introduction, which is a summary of the overall Waste Management Program, and part of the Waste Fractionization Plant Processing section which discusses in detail the processes used. (LK)

3045 (ISO-100(Del.)(Vol.2)) WASTE MANAGEMENT TECHNICAL MANUAL. Volume 2. Buckingham, J. S. (ed.). (Isochem Inc., Richland, Wash. (USA)). 31 Aug 1967. Contract AT(45-1)-1851. 466p. Dep. NTIS $26.50.

Declassified 8 Apr 1974.

Volume 2 of the Waste Management Technical Manual contains the latter part of the Waste Fractionization Plant Processing section; the Plant and Equipment section, which describes the layout of the Waste Management facilities, arrangement of equipment, and individual equipment pieces; the Process Control section, which describes the instruments and analytical methods used for process control; and the Safety section, which describes process hazards, and the methods used to safeguard against them. (LK)

3046 SOLID PROGRESS IN NUCLEAR WASTE TREATMENT. Clelland, W. (British Nuclear Fuels Ltd., Windscale, Eng.). New Sci.; 63: No. 916, 786-789(26 Sep 1974).

To increase safety and reduce the requirements for surveillance, it is recognized that the high-level liquid radioactive waste arising from nuclear fuel processing plants will, in the longer term, have to be solidified instead of being held in large stainless steel tanks as at present. The currently conceived process to this end, HARVEST, meters through a pipe-line mixer the highly active liquid waste concentrate and slurry of glass forming materials (silica and borax) into a heated container in which solidification takes place. In the container the mixture is continuously dried, calcined and incorporated into a glassy matrix. When full the container is further heated to ensure conversion of all the contents to the glassy state. The container is cooled, the external decontaminated and a submerged leach test is carried out. The container is then transported to its storage position in a pond. (UK)

3047 STABLE NUCLIDES OF FISSION-PRODUCT ZIRCONIUM IN THE SPENT FUEL OF JPR-1 AND JPDR-1. Akatsu, E.; Aratono, Y. (Japan Atomic Energy Research Inst., Tokai). Radiochem. Radioanal. Lett.; 19: No. 3, 179-186(25 Oct 1974).

Zirconium was separated from the spent fuel of Japan Research Reactor-1 and Japan Power Demonstration Reactor-1 with a method based on the adsorption on silica gel in 2M nitric acid. (auth)

3048 PRESENT STATUS OF NOBLE GAS RELEASE FROM NUCLEAR FACILITIES IN JAPAN. At. Jap.; 18: No. 2, 23-34 (Feb 1974).

Research on the method of reducing the inert (noble) gases released from nuclear facilities is under way in Japan, which is facing the pressing need to completely overcome nuclear environmental problems. Of these gases discharged from reactors, radioactive Xe and Kr become important. The removal of ^{85}Kr is more serious in the case of reprocessing plants because of large quantity involved. The present status in Japan is described on the following: release of gaseous wastes from power reactors and reprocessing plants; and noble gas removal process and the present level of development. The method developed (in Japan and overseas) includes adsorption, cryogenic distillations, solvent extraction and selective membrane process. (JA)

Radioisotope Production

3049 (GSI-tr-17/74) THERMOCHROMATOGRAPHY OF NUCLEAR REACTION PRODUCTS IN THE FORM OF CHLORIDES WITHOUT CARRIERS. Eichler, B.; Domanov, V. P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F.R. Germany)). Jun 1974. 15p. (In German). INIS.

4 figs.; 5 tabs.; 28 refs. With abstract. Translation of the Russian Report JINR-P12-7775.

The separating temperature of chlorides from 47 elements was determined from the gas flow without carriers in a thermochromatographic column filled with quartz power. A relationship between the separating temperature and standard heat of sublimation of the chlorides was observed. On this basis, conclusions were drawn from the thermochromatographic data for some elements about their chemical state under experimental conditions that one cannot predict in advance. The most probable temperature region of their separation is predicted from the extrapolated values of the standard heat of sublimation for the chlorides of the hypothetical elements 112–115. (GE)

3050 CHEMICAL GROUP SEPARATION PROCEDURE FOR SUPERHEAVY ELEMENTS AND VARIOUS OTHER REACTION PRODUCTS FROM HEAVY-ION BOMBARDED URANIUM TARGETS. Kratz, J. V.; Liljenzin, J. O.; Seaborg, G. T. (Univ. of California, Berkeley). Inorg. Nucl. Chem. Lett.; 10: No. 10, 951-957(Oct 1974).

It appears that complex formation, preferentially with heavy halide ions, provides a convenient means to isolate the superheavy element group from actinide elements and the target material. Different chromatographic separation techniques were tested to separate the superheavy element complex anions from the cationic actinides and uranium in dilute HBr/Br_2 acid systems, and it was concluded from these studies that a simple cation exchange separation is the most suitable method. This separation is presently used to process uranium targets bombarded at the Berkeley SuperHILAC. In addition to the search for superheavy elements, the same targets are used to obtain information basic to an understanding of heavy-ion reactions by measuring cross sections of various other reaction products. This is done by adding further chemical separation steps to the elution of a superheavy element fraction followed by α and γ spectroscopy. (auth)

3051 IMPROVED METHOD FOR THE PRODUCTION OF FLUORINE-18 IN A REACTOR. Chan, P. K. H.; Firnau, G.; Garnett, E. S. (McMaster Univ., Hamilton, Ont.). Radiochem. Radioanal. Lett.; 19: No. 3, 237-242(25 Oct 1974).

A new way of preparing a lithium carbonate target, which is suitable for the production of ^{18}F in a reactor, is described. Three times as much ^{18}F can be obtained by this method compared with the reactor procedures described to date. For the first time, 65-75 mCi of usable, carrier-free ^{18}F can be obtained from one enriched target after a 3-hour irradiation at 4.2×10^{13} n cm^{-2} s^{-1}. (auth)

3052 FAST SEPARATION IN THE GASEOUS PHASE OF Tc RECOIL PRODUCTS PRODUCED BY ^{252}Cf(II). Boegl, W.; Baechmann, K. (Technische Univ., Darmstadt, Ger.). Inorg. Nucl. Chem. Lett.; 10: No. 10, 805-813(Oct 1974).

In a previous publication (Bögl et al., submitted to Inorg. Nucl. Chem. letters) the separation of fission technetium in the gaseous phase was described. The fission recoils were stopped in inert gas and reactive gases (H_2O, Cl_2, HCl), added in order to form partly volatile compounds that were separated by adsorption chromatography. The experimental procedure and the treatment of the data is published in detail in the previous publication. In this work the separation of technetium using $SOCl_2$, CCl_4, $ZrCl_4$/Cl_2, Br_2 and HBr was studied. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 2834, 2855, 2870, 2871, 3347–3349, 3358, and 5372.

3053 (AEC-tr-7587) GAS-CHROMATOGRAPHIC ANALYSIS OF TBP DEGRADATION PRODUCTS IN SOLUTIONS FROM IRRADIATED-NUCLEAR-FUEL PROCESSING. Brignocchi, A.; Gasparini, G. M.; Pizzichini, M. (Comitato Nazionale per l'-Energia Nucleare, Rome (Italy)). [nd]. Translation of RT/CHI-(73)4. 15p. Dep. NTIS $4.00.

The gas-chromatography method is a rapid method for simultaneous determination in TBP of DBP, MBP, and phosphoric acid. The method is at least as sensitive as the potentiometric and much less sensitive to acid interference; it is applicable to organic and aqueous solutions. It is the only method for evaluating the degree of degradation of TBP in a process. The limits of sensitivity are around 90–100 moles/liter; its precision for DBP (100 to 800 moles/liter) is ±18 moles/liter and for MBP, ± 10 moles/liter. (auth)

3054 (CEA-CONF-2645) GENERAL ECONOMICS OF REPROCESSING OF IRRADIATED FUELS. Sornein, J.; Sousselier, Y. (CEA Direction des Productions, 92-Chatillon (France)). 1973. 11p. (In French). (CONF-730983-23). Dep. NTIS (US Sales Only) $4.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France (11 Sep 1973).

The reprocessing of irradiated fuels to separate uranium and plutonium from fission products is the last stage of the nuclear fuel cycle. The processes used call on classical methods of industrial chemistry, in particular extraction by solvents, but they are made complicated and costly by the need to deal with the risks of irradiation and contamination and to avoid reaching critical mass. Thus a reprocessing unit represents a large investment, of the order of $100 million for a plant with an annual capacity of 1,500 tons, the optimum size given the state of current technology. This corresponds to a cost of $30 to $35 per kilo, or about 7% of the costs of the nuclear fuel cycle as a whole. Reprocessing is economically justified only if the value of the products recovered is high enough. There is no doubt about this in the case of pressurized water reactors and it is probably also true for boiling water reactors. In the case of gas/graphite reactors, the value of the plutonium is the determinant factor. The European market for reprocessing fuels for water moderated reactors will only start to grow from 1975 (200 tons) on. By 1980, it should be of the order of 1,200 tons. These figures have led the French Atomic Energy Commissariat to start developing the industrial and commercial foundations for optimal reprocessing arrangements at the European level. (FR)

3055 (DOCKET-50201-152) WEST VALLEY REPROCESSING PLANT. Investigation of Structural Consequences to Existing FRS Pool Resulting from Loss of Cooling. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). Aug 1974. 28p. Dep. NTIS $4.50.

Fuel elements are stored in a 28-foot pool. Heat generated by radioactivity in the fuel elements is removed by the pool cooling system. This cooling system could conceivably cease to operate as a result of damage sustained from the effects of natural phenomena. The structural consequences to the storage basin if this cooling capacity were suddently lost are considered. (LK)

3056 (DOCKET-50201-153) WEST VALLEY REPROCESSING PLANT. Indemnity Agreement B-29, Amendment 7. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 19 Jul 1974. 2p. Dep. NTIS $4.00.

3057 (HW-19140(Del.)) URANIUM RECOVERY TECHNICAL MANUAL. (Hanford Works, Richland, Wash. (USA)). 10 Nov 1951. Contract W-31-109-eng-52. 762p. Dep. NTIS $41.25. Declassified 13 Jun 1974.

The Uranium Recovery Technical Manual was prepared to provide a documentation of the fundamental technical bases and general features of uranium recovery facilities at Hanford Works. Included in the manual are sections on safety, process control, plant and equipment, and the detailed process for recovering uranium and preparing uranium trioxide powder. (LK)

3058 (RT/CHI-(74)6) CLEAN UP OF DEGRADED SOLVENTS BY AMBERLIST A 26 RESIN. Novak, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Apr 1974. 26p. Dep. NTIS (US Sales Only) $4.50.

In the regeneration of solvents deriving from the nuclear fuels liquid-liquid reprocessing, the possibility of substituting the usual alkaline washing with a liquid-solid clean up system may be very interesting. The capacity of a basic macroreticular resin to absorb some acidic degradation products of a TBP–n-dodecane solution has been examined. (auth)

3059 (TID-26286, pp 162-165) REMARKS ON LICENSING OF NUCLEAR-FUEL-CYCLE FACILITIES. Nussbaumer, D. A. (Office of Regulation, Washington, DC). 1974.

In nuclear criticality safety.

The philosophy underlying the licensing requirements to be met by nuclear-fuel-cycle facilities is briefly reviewed. The procedural aspects required of an adequate health and safety program are discussed. Administrative procedures concerning operation, reviews of changes in processes and equipment, training, auditing, checks and balances, and emergency plans are examined. (JWR)

3060 NUCLEAR FUEL ELEMENTS AND THEIR REPROCESSING, WASTE REMOVAL, AND SHUT-DOWN OF NUCLEAR INSTALLATIONS. Herre, F. (Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen, Leopoldshafen, Ger.). pp 180-186 of Umweltschutz bei nuklearer und konventioneller energiegewinnung. Braun, H. (ed.). Stuttgart; Geog Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

The methods used for the reprocessing of nuclear fuels and for the disposal of waste products are briefly outlined. The special problems posed in the shutdown of a nuclear installation are considered. (JSR)

3061 HYDROTHERMAL PRECIPITATION OF CeO_2 FROM CERIC AMMONIUM NITRATE-NITRIC ACID SOLUTIONS. Harmon, H. D. (du Pont de Nemours (E. I.) and Co., Aiken, SC). Inorg. Nucl. Chem. Lett.; 10: No. 11, 1031-1038(Nov 1974).

Studies of the effect of Ce(IV) in promoting nitric acid dissolution of refractory PuO_2 were undertaken to develop methods for processing UO_2-PuO_2 prototype breeder reactor fuels. The purpose of the present work was to gain more understanding of the hydrothermal precipitation of CeO_2 and to determine the limitations, if any, that this phenomenon may impose upon possible UO_2-PuO_2 fuel dissolution processes that use HNO_3-Ce(IV) solutions. The effects of heating rate, Ce(IV) concentration, HNO_3 concentration and nitrate concentration were studied, and the results are discussed. (UK)

3062 RECENT DEVELOPMENTS IN THE REPROCESSING OF HTGR FUEL ELEMENTS. Kaiser, G.; Merz, E. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Chemische Technologie). Kerntechnik; 16: No. 8/9, 388-392 (Sep 1974). (In German, English).

From 24th IUPAC congress; Hamburg, F. R. Germany (2 Sep 1973). 3 figs.; 1 tab.; 14 refs. Revised version of the AED-Conf-73-407-013.

A rational reprocessing concept for HTGR fuel elements is based on a separation into three product streams, namely, thorium, uranium, and fission products. In the first process step, the so-called head-end, the matrix graphite and the PyC particle coatings are burned off and the resulting offgas is cleaned so as to reduce emission of radioactive substances as much as possible. The fuel ash is then dissolved in THOREX reagent and the fuel solution is adjusted to a system of sharply defined acidity and heavy metal concentration. This is followed by chemical separation of fertile material, fissile material, and fission products by countercurrent extraction with tri-n-butyl phosphate. Intensive work has been going on in recent years on all these process steps. New developments that have taken place are described and the development stages still required for converting the process to a large industrial scale are discussed. (auth)

CONTROLLED THERMONUCLEAR RESEARCH

3063 (TID-3557-S3) CONTROLLED FUSION AND PLASMA RESEARCH. A Literature Search. Whitson, M. O. (comp.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Nov 1974. 422p. Dep. NTIS $10.60.

Approximately 3100 references to research reports and journal articles are cited, covering work on basic plasma physics, thermonuclear devices, magnetic fields, and other topics related to controlled fusion research. A subject index is included. (auth)

Confinement and Heating

Refer also to abstracts 3115, 3146, and 3195.

3064 (AD-778481) FAST PLASMA HEATING. Final Report, 16 March 1969–31 December 1973. Kristiansen, M.; Hagler, M. O. (Texas Tech Univ., Lubbock (USA). Plasma Lab.). 28 Feb 1974. 22p. (AFOSR-TR-74-0592). NTIS $3.00.

Refraction of a carbon dioxide laser pulse was investigated for several radial density profiles in a plasma column. Beam guiding and focusing were observed when the density had a minimum on the axis, while the beam was refracted toward the wall for a density maximum on the axis. The observed heating of the plasma is consistent with classical inverse bremsstrahlung calculations. A new sensitive optical diagnostic technique for measuring electric and magnetic field distributions interferometrically by means of the Kerr and Faraday effects, respectively, has been developed. Other fast plasma heating investigations concerned exploding wires in large magnetic fields and enhancing the energy transfer to a plasma column by exciting a magnetosonic resonance of the column. (auth)

3065 (AEC-tr-7588) CONTRACTION OF PLASMA IN THE "TUMAN-2" ASSEMBLY. Berezovskii, E. L.; Gusev, V. K.; Kaganskii, M. G.; Kalmykov, S. G.; Kislyakov, A. I.; Malyshev, G. M.; Pautov, V. L.; Razdobarin, G. T.; Sololova, L. V.; Tyul'shenov, S. S.; Shakhovets, K. G. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1974. Translation by William J. Grimes of Preprint No. 641. 28p. Dep. NTIS $4.50.

Experiments in ohmic heating and plasma compression were performed using the "Tuman-2" toroidal device. A plasma with a concentration of approximately 10^{13} cm^{-3} and an electron temperature of 20 to 30 eV was obtained using ohmic heating in a toroidal field of 3 to 5 kOe. Effective compression of the plasma was achieved by increasing the toroidal field from 3.2 to 11.5 kOe in 125 μsec. The plasma concentration increased by a factor of 3 and the electron temperature by a factor of 2.5. It was established that the compression heating was produced by an improvement of the thermal insulation of the plasma. At the same time, a decrease in the plasma oscillations and an attenuation of the interaction of the plasma with the diaphragm was observed. Measurements of the radial concentration distribution showed that the rate of transverse diffusion decreases significantly during compression. The coefficient of diffusion $D \lesssim 2 \times 10^3$ cm^2 per second for the compressed plasma, amounting to less than 0.1 of the Bohm diffusion coefficient and agreeing with the coefficient given by pseudoclassical theory. (auth)

3066 (CONF-741105-22) PLASMA CONFINEMENT AND HEATING IN THE ELMO BUMPY TORUS (EBT). Dandl, R. A.; Eason, H. O.; Guest, G. E.; Hedrick, C. L.; Ikegami, H.; Nelson, D. B. (Oak Ridge National Lab., Tenn. (USA)). 1974. 13p. (CN-33/B6). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The ELMO Bumpy Torus (EBT) is a toroidal magnetic trap in which microwave heating is used to produce steady-state, high-beta plasmas. The confined plasma consists of an annular, mirror-confined, relativistic-electron component localized near the midplane of each of the 24 identical sectors of EBT; and a less energetic circulating ("toroidal") component with more nearly isotropic pressure. The plasma is formed and heated (and maintained in steady state) by two 18-GHz klystron amplifiers producing 30 kW (cw); two traveling-wave amplifiers at 55 GHz producing 10 kW (cw); and 5 kW (cw) additional power at 10.6 GHz. Depending on ambient gas pressures, three distinct modes of plasma behavior are observed: a cold-plasma mode (C-Mode) at high pressure; a quiet mode with significant stored energy at intermediate pressures (T-Mode); and a mode with large stored energy but high fluctuation levels at low pressure (M-Mode). In the T-Mode typical parameters are: for the toroidal component: $n_e \sim 1\text{-}3 \times 10^{12}/\text{cm}^3$; $T_e > 100$ eV; $T_i < 75$ eV; for the annular component: $n_e \simeq 8 \times 10^{10}/\text{cm}^3$; $T_e \simeq 900$ keV; $\beta \simeq 0.4$. The observed stability is consistent with a body of theoretical results developed for EBT; while the observed confinement suggests that neoclassical transport mechanisms may dominate in the T-Mode, where observed particle replacement times are 10's of milliseconds. (auth)

3067 (ORO-3871-9) ION RESONANCE HEATING STUDIES. Progress Report, November 15, 1973–November 14, 1974. Swanson, D. G. (Texas Univ., Austin (USA). Plasma Research Lab.). 1974. Contract AT(40-1)-3871. 76p. Dep. NTIS $7.00.

A cold plasma model describing the spatially varying static magnetic field without electron inertia is analyzed with conducting boundary conditions. It is found that the fast wave is affected only very slightly with a very slight lowering of the waveguide cutoff frequency due to toroidicity, and several cavity mode resonances are calculated. The slow wave, or ion cyclotron wave, is profoundly affected with a singularity or singularities occurring at a constant major radius where the wave changes from an oscillating nature to an evanescent nature near but not at the ion cyclotron frequency. This mode of preparation is still not well understood because of the complicated structure of the singular differential equations. A study of the warm plasma boundary conditions is included which indicates the usual cold plasma boundary conditions are probably inconsistent for fusion plasmas, although we include the cold plasma boundary conditions for reference. The rf heating experiment is in the early stages of low power operation with the basic device completed, and the neutral atom energy analyzer is completed and being calibrated. A description of the linear multiple mirror machine is included. (auth)

3068 (UCRL-75511) PLASMA CONTAINMENT IN 2XII. Coensgen, F. H.; Cummins, W. F.; Molvik, A. W.; Nexsen, W. E. Jr.; Simonen, T. C.; Stallard, B. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Sep 1974. 11p. (CONF-741105-31). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Experiments in the 2XII magnetic mirror device have achieved high beta ($\beta \approx 0.3$ to 0.5) plasma confinement. Near classical confinement was observed in the range 2 to 5×10^{13} cm^{-3} with average ion energies of 1 to 3 keV. The measured electron energy, 50 to 150 eV, was consistent with classical energy transfer from the hot ions. At lower plasma densities, the loss rate departs from classical confinement owing to quasi-classical scattering and ion cyclotron fluctuations. The injection of a 10-A, 20-keV neutral atom beam produced no beam-driven instabilities, nor did it increase charge exchange losses. (auth)

3069 (UCRL-75512) PLASMA PRODUCTION AND CONFINEMENT IN THE BASEBALL II MIRROR EXPERIMENT. Anderson, O. A.; Birdsall, D. H.; Damm, C. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Sep 1974. 14p. (CONF-741105-18). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The problem of plasma buildup in a steady-state magnetic-mirror field is being explored in the Baseball II experiment. Methods under investigation utilize neutral-beam injection either with or without a target plasma. Results are reported for buildup starting from a high vacuum, without a target. To reduce the likelihood of microinstability, an ion distribution broadened by Coulomb scattering is obtained. With injection at energies less than 2 keV in a high-vacuum environment, the mirror losses were found to substantially exceed charge-exchange losses, indicating a broadened ion distribution. However, the threshold density for ion-cyclotron instability was no higher than in previous experiments that were dominated by charge exchange. The onset of instability is observed to depend on beam geometry, and instability signals are usually absent shortly after beam injection ceases. The spatial and temporal distribution of anomalous losses is related to potential perturbations rotating at frequencies near the ion grad-B drift. Anomalous losses increase rapidly as the injected beam increases, limiting the density to $3\text{-}5 \times 10^9$ cm^{-3}. A pulsed hydrogen discharge in minimum-B geometry for use as a target plasma was also studied. Densities of 10^{13} to 10^{14} cm^{-3} were measured in a 5-cm-diameter discharge with electron temperature of 5 to 15 eV. Calculations show satisfactory hot-plasma buildup with 50-A pulsed injection. (auth)

3070 (UCRL-75953) PARAMETRIC SURVEY FOR THE LINEAR TWO-COMPONENT SYSTEM. Heckrotte, W.; Hiskes,

J. R.; Freis, R. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Sep 1974. 16p. (CONF-741105-14). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

A parametric study is presented for the linear, two-component, mirror fusion system in which the interrelationship of the important system parameters is displayed. The distribution function of the high energy component and related functions are calculated from the Fokker–Plank equation. These functions are conveniently parametrized by the ratio of injection energy to the target electron temperature. The Q values for the two-component system are found to be increasing functions of the injection energy up to 200 keV and then to exhibit a broad maximum from 200 to 600 keV. The optimum Q values are significantly greater (>2) than for the conventional mirror system. System lengths are derived as a function of the magnetic field, target electron temperature, plasma potential, and α-particle heating. For a given Q (or injection energy/electron temperature ratio) the system lengths, which may be long, are balanced against magnetic field values, which may be large. Effective bounds on several parameters are established. The presence of α particles in the system may result in the development of a deuterium "halo" surrounding the target plasma, which can severely attenuate the incident beam. Accommodation of these "halo" effects necessitates a longer system. (auth)

3071 (UCRL-75993) THEORETICAL STUDIES OF PLASMA CONFINEMENT IN MAGNETIC MIRRORS. Parts I and II. Rensink, M. E.; Fowler, T. K.; Freis, R. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Sep 1974. 15p. (CONF-741105-17). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The plasma confinement parameter $\langle n_\tau \rangle$ and the maximum β consistent with ideal MHD stability are computed for various values of the mirror ratio R and ion source injection angle θ_0. The mathematical model that yields this information is the velocity-space Fokker–Planck equation for the ion and electron distribution functions. For an idealized plasma configuration, the modification of the magnetic field due to finite β is calculated. The computation of self-consistent, finite-β plasma equilibrium is given with application to mirror magnetic wells. The omnigenity of some nonaxially-symmetric cells is illustrated, and the results of solving magnetic differential equations on an Eulerian grid to compute field line integrals are shown. (auth)

3072 PLASMA HEATING CALCULATIONS USING A TRANSFORM METHOD. Eltgroth, P.G. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Fluids 17: No. 8, 1602-1607 (Aug 1974).

The problem of a strongly driven one–dimensional electrostatic plasma is treated by the method of expansion of the distribution function in terms of Hermite polynomials in velocity space. Numerical results for hydrodynamic variables are similar to those found in simulation calculations. The shapes of the ion and electron distribution functions are significantly altered from Maxwellian form during heating. (auth)

3073 RELATIVISTIC ELECTRON DYNAMICS IN A CUSPED MAGNETIC FIELD. Rhee, M.J.; Destler, W.W. (University of Maryland, College Park, Maryland 20742). Phys. Fluids 17: No. 8, 1574-1581 (Aug 1974).

Single–particle motion of relativistic electrons in a cusped magnetic field has been studied both analytically and experimentally. The Lagrangian formulation is used to solve for the electron trajectories in some simple magnetic cusp configurations. A threshold energy for transmission through the cusp is found, and confirmed experimentally. Two different electron orbit off–centering mechanisms are discussed; one arising from a nonzero radial component of particle velocity on the upstream side of the cusp transition, and another arising from the finite width of the cusp transition. Experiments are reported confirming the existence of these off–centering mechanisms, and the results are compared with theoretical expectations. (auth)

3074 COLLISIONAL COUPLING IN COUNTERSTREAMING LASER–PRODUCED PLASMAS. Koopman, D.W.; Goforth, R.R. (Institute for Fluid Dynamics and Applied Mathematics, University of Maryland, College Park, Maryland 20742). Phys. Fluids 17: No. 8, 1560-1565 (Aug 1974).

The collisional processes which transfer momentum between conterstreaming plasmas are reviewed and applied to the example of a laser–produced plasma expanding into a partially ionized background. Experimental measurements of the dependence of the ion flow field on collisional momentum transfer demonstrate the validity of the simplified treatment of collision processes which have been adopted. A numerical model which simulates the laser–plasma interaction with the background confirms the importance of collisions in previous experimental studies of momentum coupling, and provides some insight into the distinction between collisional and collisionless flow regimes. (auth)

3075 COMMENTS ON "LASER LIGHT FORCES AND SELF–FOCUSING IN FULLY IONIZED PLASMAS". Klíma, R.; Petržilka, V.A. (Institute of Plasma Physics, Czechoslovak Academy of Sciences, Prague, Czechoslavakia). Phys. Fluids 17: No. 8, 1640-1640 (Aug 1974).

An earlier derivation (Shearer and Eddleman, Phys. Fluids 16, 1753(1973) of basic equations describing the radiation pressure effects of laser radiation in plasma is discussed. Some inconsistances in their analysis are pointed out. It is pointed out that the multiplier term is not the proper term for the momentum density. A comment on collisional electron–ion interactions is also questioned. (MOW)

3076 REPLY TO COMMENTS BY R. KLÍMA AND V. A. PETRZILKA: Shearer, J.W.; Eddleman, J.L. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Fluids 17: No. 8, 1641-1641 (Aug 1974).

It is pointed out that Klima and Petrzilka are correct in their analysis that ϵ is not the proper multiplier for the momentum density. It is also pointed out that the entire analysis was done using the collisionless approximation. (MOW)

3077 QUASISTATIC CALCULATION OF RADIAL PLASMA VELOCITY IN LASER–HEATED SOLENOID. Halverson, W. (Francis Bitter National Magnet Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). J. Appl. Phys. 45: No. 12, 5209-5210 (Dec 1974).

The one–dimensional quasistatic model of a laser–heated magnetically confined plasma is used to compute the radial plasma flow velocity. (auth)

3078 FREQUENCY–DEPENDENT ABSORPTION EFFICIENCY AND NEUTRON PRODUCTION IN LOW–ENERGY LASER IRRADIATION OF SLAB TARGETS. Goldman, E.B. (Laboratory of Laser Energetics, College of Engineering and Applied Science, University of Rochester, Rochester, New York 14627). J. Appl. Phys. 45: No. 12, 5211-5217 (Dec 1974).

A series of numerical experiments have been performed to examine the efficiency of the coupling of laser energy into a plasma target. Classical inverse bremsstrahlung absorption is considered in both the weak– and strong–field limits at laser intensities from $\sim 10^{15}$ to $\sim 10^{16}$ W cm^{-2} at the fundamental and first harmonic neodymium laser frequencies. Frequency multiplication from the fundamental to the harmonic is shown to lead to desirable results even if the conversion efficiency is low. The computed absorption, x–ray generation, and neutron production are compared with experimental results. Nonthermal mechanisms are discussed to account for the result that much larger neutron production is found experimentally than can be accounted for in a numerical model. (auth)

3079 OBSERVATION OF LASER–DRIVEN SHOCK WAVES IN SOLID HYDROGEN. van Kessel, C.G.M.; Sigel, R. (Max–Planck–Institut für Plasmaphysik—EURATOM Association, 8046 Garching bei München, Germany). Phys. Rev. Lett. 33: No. 17, 1020-1023 (21 Oct 1974).

The spatial development of laser–driven shock waves in a plane solid–hydrogen target was directly observed by high–speed photography. From the measured shock–front velocity a peak pressure of 2 Mbar is evaluated at the onset of a 10–J, 5–nsec Nd laser pulse. The underlying mechanism of laser ablation and the relevance of such measurements to laser fusion and the behavior of matter at extremely high pressures are discussed. (auth)

3080 MAGNETICALLY INDUCED PLASMA ROTATION. Witalis, E. A. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Z. Naturforsch., a; 29: No. 8, 1138-1142(Aug 1974). 27 refs.

The extensively studied and controversial question about the origin of the observed fast rotation for magnetically confined plasmas, in particular theta pinches, is briefly reviewed. It is shown that standard MHD equations predict the experimentally observed rotation. The effect is interpreted as a form of the Einstein-de Haas effect. The generally accepted continuum plasma reasoning which denies any appreciable electromagnetic angular momentum transfer to an azimuthally symmetric plasma volume is shown to be too simplified. (auth)

Diagnostics

Refer also to abstracts 3159 and 4462.

3081 (JPRS-61878) DIAGNOSTICS OF DENSE LASER PLASMAS AND SUPERDENSE HOT PLASMAS. Aglitskii, E. V.; Voiko, V. A.; Vinogradov, A. V.; Yukov, E. A.; Sobelman, I. I. (AN SSSR, Moscow. Fizicheskij Inst.). 1 May 1974. Translation of Preprints Nos. 145 and 173. 36p. NTIS $3.25.

Methods for determining the temperature and density of plasma produced by the sharp focusing of a laser beam onto the surface of a condensed material and diagnostics of hot and very dense laser-produced plasmas are discussed. (auth)

3082 (UCRL-75713) INSTRUMENTATION FOR X-RAY DIAGNOSTICS OF PLASMAS. Violet, C. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Oct 1974. 37p. (CONF-740809-10). Dep. NTIS $5.00.

From 23rd annual conference on applications of x-ray analysis; Denver, Colorado, USA (7 Aug 1974).

Measurements of x rays emitted by hot plasmas provide a powerful diagnostic method of determining important plasma parameters and suggest certain types of plasmas as possibly useful x-ray sources. Instrumentation to accomplish these measurements for various types of plasmas are reviewed. State-of-the-art x-ray spectrometers, calorimeters, and source-imaging devices, designed especially for plasmas generated by focused, nanosecond laser pulses are described. Possibilities of time-resolved measurements on such short-lived plasmas are discussed. (auth)

3083 DENSITY MEASUREMENT OF PLASMA WITH A SMALL DIAMETER BY MICROWAVE INTERFEROMETER. Kuwahara, C.; Matsuura, K.; Miyahara, A. (Nagoya Univ., Japan). Jap. J. Appl. Phys.; 13: No. 2, 327-333(Feb 1974).

For a plasma column with a small diameter comparable to the wavelength of a microwave interferometer, the density cannot be obtained from phase shift measurements. The density of this case was estimated by supposing that the received wave with an antenna consists of two components; one which is independent of the plasma density, transmitted in free space outside the plasma and the other which is dependent on density, transmitted through the plasma. The latter component has been shown to obey nearly the same relationship between the phase shift and the plasma density as in the case of a plasma slab by means of experiments and the scattering theory. (auth)

3084 SYSTEMS FOR MEASURING THE PROPERTIES OF PLASMA WITH AN ION PROBE. Jobes, F. C. Jr.; Hickok, R. L. Jr. (to Mobil Oil Corp.). US Patent 3,833,851. 3 Sep 1974. Filed date 15 Oct 1971. 12p.

An ion source generates a heavy-ion beam of uniform ion velocity which is utilized to probe plasmas. The beam is scanned through a plane by deflection plates and the angle of scansion for the beam is magnified by a linear field distribution lens. The ionizing collisions between the scanned beam and the plasma results in a step charge change for the ions. Detectors are provided which are responsive to the ions undergoing a step change in charge to measure electron density of the plasma, space potential of the plasma, and the momentum added by the plasma current. (Official Gazette)

3085 ON–LINE CORRELATION MEASUREMENT IN A PLASMA. Ogata, A.; Matsuura, K. (Institute of Plasma Physics, Nagoya University, Nagoya, Japan). Rev. Sci. Instrum. 45: No. 9, 1077-1081 (Sept 1974).

An on–line system to measure correlation functions in a plasma is described. By combining a fast buffer memory and a digital computer, the system can analyze signals with up to 4 MHz bandwidth and has direct applications to pulsed plasmas. Hardware and software for the system are described together with a few applications. (auth)

3086 HOLOGRAPHIC INTERFEROGRAMS OF SIDE–BY–SIDE EXPLODING WIRES. Seftor, J.L. (Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico 87117). J. Appl. Phys. 45: No. 11, 5082-5083 (Nov 1974).

Holographic interferograms have been made of two aluminum wires exploding side by side in a vacuum environment. The resulting refractivity data demonstrates the relevant character of the event for a laser interaction experiment. In addition, lower bound values of specie density have been estimated. (auth)

3087 BEHAVIOR OF ELECTRON–EMITTING PLASMA PROBES IN THE SPACE–CHARGE–LIMITED REGIME. Schuss, J.J.; Parker, R.R. (Research Laboratory of Electronics and Department of Electrical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). J. Appl. Phys. 45: No. 11, 4778-4783 (Nov 1974).

The properties of cylindrical electron–emitting plasma probes are reviewed. Poisson's equation is formulated and solved for a cylindrical emissive probe biased several volts negative of plasma potential and operating in the space–charge–limited regime. It is shown that in this regime the emitted current at fixed voltage is proportional to the reciprocal of the Debye length. The theory is shown to be in good agreement with experimental results. Expected deviations of probe behavior from the theory and the theory's limitations are discussed. Due to the emission limitations of such probes the technique appears useful only for those plasmas whose Debye length is greater than about 10^{-2} cm. (auth)

3088 GATED OPTICAL MULTICHANNEL ANALYZER FOR RUBY LASER SCATTERING FROM PLASMA. Offenberger, A.A.; Burnett, N.H.; Strilchuk, A.R.; Way–Nee, D.F. (Department of Electrical Engineering, University of Alberta, Edmonton, Canada). Rev. Sci. Instrum. 45: No. 11, 1400-1402 (Nov 1974).

An optical detection system is described which employs a commercial multichannel analyzer augmented by a flat spectral response image intensifier and Kerr shutter to provide time–resolved, sensitive detection of plasma scattered ruby laser light. Operation characteristics are discussed and scattered spectra from CO_2 laser induced hydrogen plasma are shown. (auth)

3089 SMALL–SIGNAL TRANSIT–TIME ANALYSIS OF A PLANAR MOBILITY–DOMINATED ION SHEATH. Oliver, B.M.; Smy, P.R. (Department of Electrical Engineering, University of Alberta, Edmonton, Alberta, Canada T6G 2G7); Clements, R.M. J. Appl. Phys. 45: No. 12, 5245-5250 (Dec 1974).

The effective impedance of a planar collision–dominated ion sheath for frequencies below the electron plasma frequency has been obtained from a solution of the small–signal equations of motion expressed in Eulerian coordinates. The analysis assumes a well–defined sheath boundary and is similar to a previous study by Llewellyn on collisionless diodes. The results of the present analysis show a sheath capacitance component which is highly dependent on the probing frequency relative to the ion transit time in the sheath. Good agreement is obtained between theoretical predictions and experimental measurements of the sheath capacitance as a function of frequency, probe potential, and probe current. The plasma source was the positive column of a high–pressure (10 Torr) helium dc discharge with a plasma electron density between 5×10^{15} and 4×10^{17} m^{-3} and a temperature $\simeq$23000 °K. (auth)

3090 HIGH TIME RESOLUTION ELECTROSTATIC ELECTRON ANALYZER. Lohr, J. (Fusion Research Center, University of Texas at Austin, Austin, Texas 78712). Rev. Sci. Instrum. 45: No. 9, 1168-1169 (Sept 1974).

A gridded electrostatic electron energy analyzer is described which has been used successfully to time resolve trapped electron distributions at 200 MHz in a beam plasma device. Examples of raw data and extracted phase space plots are presented. (auth)

3091 POLARIZATION MEASUREMENT ON SPECTRAL LINES OF LOW INTENSITY AND SHORT DURATION. Danielsson, L.; Lindberg, L. (Kungliga Tekniska Hoegskolan, Stockholm). J. Phys., E (London); 7: No. 10, 817-820(Oct 1974).

Measurement of the polarization of spectral lines emitted from a plasma in a magnetic field can give valuable information about the anisotropy of the electron velocity distribution. Practically, this means measurement of the polarization of a weak, moving three-dimensional light source of short duration. Careful design and adjustment of the optical and photoelectric equipment is necessary to avoid sources of systematic error. The design and optimization of the equipment is discussed in detail. Measurements have been made on helium lines at a helium density of about 10^{20} m^{-3} (3 mTorr). (auth)

Kinetics (General)

Refer also to abstract 4282.

3092 (AD–772538/5GA) LINE RADIATION FROM A PLASMA WITH ENERGY TRANSFER BETWEEN IONS AND ELECTRONS VIA COULOMB SCATTERING. Volume I. Final Report, 1 May 1972–30 September 1973. Wilson, R. N. (Mission Research Corp., Santa Barbara, Calif. (USA)). 27 Nov 1973. Contract DNA001-72-C-0145. 75p. (MRC-R–53; DNA–3184F-1). NTIS $3.75.

The problem of steady-state non-local thermodynamic-equilibrium line-radiation transport is formulated for a plasma consisting of two-level ions and electrons. The treatment allows energy transfer between the translational degrees of freedom of the ions and the radiation field. Energy transfer mechanisms are discussed. The system of coupled rate equations and radiation transport equation is solved by linearizing the rate equations in electron temperature and solving the radiation transport equation in Eddington approximation. Analytic results for effective volume emission rate due to radiated energy, and numerical results for the variation of electron temperature and the level populations with position in the plasma, along with some qualitative arguments supporting the theory are presented. (auth)

3093 (AD-772542/7GA) LINE RADIATION FROM A PLASMA WITH ENERGY TRANSFER BETWEEN IONS AND ELECTRONS VIA COULOMB SCATTERING. Volume II. Final Report, 1 May 1972-30 September 1973. Wilson, R. N. (Mission Research Corp., Santa Barbara, Calif. (USA)). 27 Nov 1973. Contract DNA001-72-C-0145. 57p. (MRC-R-60; DNA-3184F-2). NTIS $3.75.

The steady state problem of non-local thermodynamic-equilibrium line-radiation transport for a plasma consisting of two-level ions and electrons is formulated and solved. The treatment allows energy transfer between an infinite energy (temperature) reservoir and the radiation field. The energy transfer mechanisms are discussed. The system of coupled rate equations and radiation transport equation is solved by linearizing the rate equations and radiation transport equation in the deviations of the electron temperature and ion kinetic temperature from their values in the central portion of the slab. The resulting system of equations is solved in the low temperature approximation in first Eddington approximation. Results for the fractional energy loss of radiated energy are presented. (auth)

3094 (AD-773977) INFLUENCE OF NEGATIVE ION PROCESSES ON THE STABILITY OF MOLECULAR GAS DISCHARGES. Nighan, W. L.; Wiegand, W. J. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). 1 Feb 1974. Contract N00014-72-C-0380. 70p. (UARL-N-921325-3). NTIS $3.75.

Theoretical and experimental studies of negative ion processes and their influence on the stability of weakly ionized glow discharges have been conducted. Emphasis in these investigations has been directed toward analysis of gas mixtures in which negative ions are produced by dissociative electron attachment of CO_2, CO, or O_2. It is shown that attachment and detachment reactions normally occurring in discharges containing these species can significantly affect both the steady state and transient characteristics of the plasma, even when an external source of ionization is provided. The electron temperature dependence of the electron-molecule attachment coefficient is found to be particularly important in determining the occurrence of ionization instability. (auth)

3095 (AD-774018) EXCITATION DATA ON SODIUM-MERCURY-NITROGEN PLASMA. Final Report, April 1968-February 1973. Krause, L. (Windsor Univ., Ontario (Canada). Dept. of Physics). Aug 1973. Contract F33615-68-C-1511. 181p. (AFAL-TR-73-342). NTIS $5.50.

In order to obtain data on the various excitation processes in a Na-Hg-N_2 plasma, the population and decay of excited atomic and molecular states in mercury and the collisional transfer of excitation from Hg to Na atoms were investigated experimentally and theoretically. Excited Hg atoms in pure mercury vapor at very low densities and in mixtures with various gases were studied using methods of delayed coincidences. (auth)

3096 (AD-777302) RESEARCH ON HIGH DENSITY NANOSECOND SPARK LIGHT SOURCES. Interim Scientific Report, 1 June 1972-31 May 1973. Fischer, H. (Technische Univ. Darmstadt (F. R. Germany)). Nov 1973. 40p. (EOARD-TR-74-7). NTIS $3.75.

The major research efforts of the past year are described. The effects of the spark gap and stray capacities on the operation of a nitrogen laser were analyzed. The power from such a laser was increased by a factor of 4 by selecting a matching capacity. A nanosecond standard light source was developed by calibrating a 'nanolite' in terms of a calibrated dc carbon arc. Results of studies using both a 1 and 5 kilojoule dense plasma focus device are described. (auth)

3097 (IAE-2283) INTENSITY DISTRIBUTION IN WINGS OF HYDROGEN SPECTRAL LINES DURING STARK BROADENING IN A PLASMA. Sholin, G. V.; Demura, A. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 16p. (In Russian). INIS.

Asymptotic formulas were obtained for the distribution of intensity in the wings of hydrogen spectral lines undergoing Stark broadening in a plasma. In deriving the formulas, the action of plasma ions on the emitter atom is considered within the framework of a quasistatic approximation, while the action of electrons is considered within the framework of a shock approximation. It is shown that the region of strong electric fields, where the Stark components behave like isolated lines, and the region of weak fields, where they run together into a single undisplaced component, differently affect the line profile in the wing: the main contribution to the wing is provided by the region of isolated Stark components. In this case it turns out that the dispersion contribution of the lines to the wing is caused in practice only by the central components. Results of numerical calculations are presented for the principal lines of the Lyman and Balmer series. A comparison with precision experiments confirms the theory which was developed. (SJR)

Kinetics (Experimental)

Refer also to abstract 3091.

3098 NEW METHOD FOR ION SPECIFICATION IN A STEADY STATE MAGNETIZED PLASMA. Saad, H. M. (Nagoya Univ., Japan). Jap. J. Appl. Phys.; 13: No. 3, 521-523(Mar 1974).

The H_1^+ and H_2^+ inside the bulk of a steady state magnetized plasma could be quantitatively measured without serious change in the plasma condition. An instantaneous axial gradient magnetic field is applied at the region under study along the axis. The particles are then accelerated towards the detecting system of the electrostatic analyzer where they reach at different times since they have the same energy but different masses. Both of the detector and the accelerator, producing the axial gradient magnetic field, are placed outside the plasma volume, therefore a minimal and limited perturbing effect is introduced. (auth)

3099 ENERGETIC PARTICLE DISTRIBUTION IN A TOROIDAL PLASMA WITH NEUTRAL INJECTION HEATING. Cordey, J.G.; Core, W.G.F. (United Kingdom Atomic Energy Authority Research Group, Culham Laboratory, Abingdon, Berkshire, United Kingdom). Phys. Fluids 17: No. 8, 1626-1630 (Aug 1974).

The energetic ion distribution resulting from the injection of high-energy neutrals into a toroidal plasma has been derived. An appropriate kinetic equation which contains the angular scattering, friction, and diffusion of the energetic ions by the background particles, charge exchange on the background neutrals, and acceleration of the ions by the electric field has been solved analytically by use of the WKBJ method. Collisions of the energetic ions with the faster moving electrons results in some of the ions increasing their energy above the injection energy. The width of this "high-energy tail" is shown to depend upon the electron temperature and the electric field. An estimate of the effect upon the width of this tail of collisions between the energetic ions themselves is also given. Finally, illustrated examples of the various significant physical processes are presented. (auth)

3100 TECHNIQUE FOR MEASURING THE AZIMUTHAL ELECTRICAL CONDUCTIVITY OF A PLASMA USING A COIL. Sugawara, M.; Ieiri, T. (Gunma Univ., Kiryu, Japan). J. Phys., D (London); 7: No. 12, L142-L145(11 Aug 1974).

A technique was developed for measuring the azimuthal electrical conductivity of a plasma using a coil wound around a discharge tube. Under the assumption that the electrical conductivity in the plasma is isotropic, the results are compared with the axial value measured. (auth)

3101 REFLECTION OF AN IMPULSIVE PLANE WAVE BY AN ANISOTROPIC PLASMA HALF-SPACE. Stanic, B. V.; Skoric, M. M. (Univ., Belgrade). J. Phys., D (London); 7: No. 12, L137-L141(11 Aug 1974).

By the use of a perturbation method, the expressions for transient electromagnetic fields reflected from a cold anisotropic lossy plasma half-space are given in a closed form. Good agreement between direct numerical results and perturbation solutions is obtained for normalized cyclotron and collision frequencies $\alpha_c = \omega_c/\omega_p \leq 0.3$ and $\alpha_\nu = \nu/\omega_p \leq 0.3$. (auth)

Kinetics (Theoretical)

Refer also to abstracts 3085, 4230, 4243, 5041, and 5080.

3102 (AD-778650) AXISYMMETRIC MULTIFLUID SIMULATION OF HIGH BETA PLASMAS WITH ANISOTROPIC TRANSPORT USING A MOVING FLUX COORDINATE GRID. Anderson, D. V. (Naval Research Lab., Washington, D. C. (USA)). Apr 1974. 49p. NTIS $3.25.

A method for solving the complete set of multifluid MHD equations is given. The algorithm slide, which is derived from flux corrected transport methods, is used to solve the fluid equations on a moving 2D axisymmetric coordinate grid in which one set of grid lines represents magnetic flux surfaces while a second set is constructed orthogonal. Preservation of the diagonal form of transport tensors allows accurate representation of anisotropic transport. Results are shown for a problem in theta-pinch geometry and are contrasted to the results of a more conventional (R,Z) code. (auth)

3103 (IAE−2318) TRANSITIONS IN TWO-LEVEL SYSTEM UNDER THE ACTION OF PLASMA MICROFIELD. Selidovkin, A. D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 22p. (In Russian). INIS.

A theory is developed for the quantum transitions in a two-level system under the action of a plasma microfield. Primary attention was devoted to three aspects: (1) the effect of the collective particle interaction on the (multitime) distribution of the microfield which determines along with a solution of the dynamic problem the true probability of transition; (2) the condition of reducing the general problem to the ordinary problem on transitions during binary collisions; and (3) a possibly more complete solution of the dynamic problem on the transition probability in a two-level system. As an example the 2s-2p-transition in the hydrogen atom is considered. (SJR)

3104 (ITF-74-75P) CURRENT CORRELATION FUNCTIONS AND NONLINEAR SUSCEPTIBILITY OF NONEQUILIBRIUM ISOTROPIC PLASMA. Kocherga, O. D. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The relation between spectral representation of the current density fluctuations and imaginary parts of nonlinear electric susceptibilities in nonequilibrium isotropic plasma is considered. The relations are obtained generalizing the fluctuation−dissipation theorem for nonequilibrium isotropic medium in which the nonlinear effects play an essential role. (auth)

3105 (N−74−22354) THERMAL RELAXATION OF A TWO DIMENSIONAL PLASMA IN A DC MAGNETIC FIELD. Part 1. Theory. Hsu Jang-Yu; Montgomery, D.; Joyce, G. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jan 1974. Contract AT(11-1)-2059. 15p. (NASA-CR−138170). NTIS $4.00.

A theory is presented for the rate of thermal relaxation of a two dimensional plasma in a strong uniform dc magnetic field. The Vahala−Montgomery kinetic description is completed by providing a cut off time for the time of interaction of two particles which contribute to the collision term. The kinetic equation predicts that thermal relaxation occurs as a function of the dimensionless time. By contrast, in the absence of an external magnetic field, a two dimensional plasma relaxes. (auth)

3106 DIFFUSION BOUNDARY LAYER IN A WEAKLY IONIZED GAS. Shioda, S. (Tokyo Inst. of Tech.). J. Phys. Soc. Jap.; 36: No. 3, 857-860(Mar 1974).

The ambipolar diffusion boundary layer induced in a thermally ionized high pressure gas is analyzed theoretically with the isothermal assumption. The thickness of the boundary layer and the density and potential profiles are calculated analytically. These results are compared with those given by the nonlinear ambipolar diffusion theory for the positive column of a weakly ionized gas discharge. (auth)

3107 THEORY OF SUPERPINCHED RELATIVISTIC ELECTRON BEAMS. Poukey, J.W.; Toepfer, A.J. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Fluids 17: No. 8, 1582-1591 (Aug 1974).

Numerical simulation and analytic theory are used to study the z−dependent equilibria of a charge neutralized, relativistic electron beam, subject to an applied axial electric field. The analytic theory consists of nonparaxial envelope equations derived from a finite temperature fluid model for relativistic beams. The application of the theory to the calculation of beam pinching in high−current relativistic electron beam accelerator diodes is discussed. An effect of the applied electric field in the diode is to enhance beam pinching, for configurations relevant to both low− and high−impedance diodes. In certain cases, the highly−pinched beams have more energy in the random motion of the beam particles than in the longitudinal flow. (auth)

3108 EFFECT OF THE FORM OF THE ELECTRON ENERGY DISTRIBUTION FUNCTION ON THE DISTRIBUTION OF THE ELECTRON CONCENTRATION IN AN ELECTRIC FIELD, THE ELECTRON CURRENT TO THE WALL, AND THE SCREENING OF PLASMA. Vasil'eva, I.A. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 12: No. 1, 26-31 (Sept 1974).

The effect of the electron energy distribution function on the screening of plasma is explained. An approximate analytical expression is selected for the isotropic part of various electron−distribution functions in a weakly ionized plasma in the range of fairly low energies. Relationships are found between the electron concentration and the potential for various distribution functions. Analytical expressions are derived for this relationship in the case of small and fairly large repulsive potentials. The expression for small potentials is used in order to linearize the Poisson equation in the problem of the self−consistent field in plasma. It is found that the form of the distribution function has a considerable effect on the screening radius, since the number of slow electrons in the plasma depends on the form of the distribution function. A relationship is obtained for the electron current to the wall as a function of wall potential. (auth)

3109 ASYMPTOTIC METHODS OF CALCULATING KINETIC COEFFICIENTS. Palkina, L.A.; Smirnov, B.M. (I. V. Kurchatov Institute of Atomic Energy). High Temp. 12: No. 1, 32-40 (Sept 1974).

An asympototic method is proposed for calculating kinetic transfer coefficients, which is valid in the case when the thermal energy of the particles exceeds considerably the depths of their interaction potential well. The method is based on the sharpness of the change of the interaction potential U (R) of particles in the region of distances R_0 between them where it is of the order of the thermal energy $U(R_0) \sim T[U' (R_0)R_0/U(R_0) \gg 1]$. The accuracy of the method is evaluated. On the basis of this method the transfer coefficients (viscosity and heat conductivity) are calculated for all inert gases in the temperature range from 2000 to 12,000°K. (auth)

3110 RELAXATION OF LONGITUDINAL AND TRANSVERSE PLASMA TEMPERATURES. Rubtsov, V.B. (P. Lumumba University of Friendship between Peoples). High Temp. 12: No. 1, 41-45 (Sept 1974).

The distribution function is used to calculate the relaxation time of the longitudinal and transverse plasma temperatures described by the Landau kinetic equation [1,2]. In the absence of a loss cone (s=0) and with a small difference between the transverse and longitudinal temperatures $(T_\perp - T_\| < T)$ the results obtained reduce to the results of [1]. The case s=1, presence of a loss cone, is examined in detail. In this case the relaxation time differs from the result obtained in [1] by 12.5%. (auth)

3111 DIFFUSION AND DRIFT OF ELECTRONS IN GASES. Huxley, L. G. H.; Crompton, R. W. Wiley Series in Plasma Physics. New York; John Wiley and Sons, Inc. (1974). 694p. $34.95.

After an introductory survey of early investigations the following topics are discussed: (1) Maxwell-Boltzmann equation and related topics, (2) restricted theory of drift and diffusion, (3) general theory of diffusion and drift in a uniform and constant electric field, (4) theory of swarm methods, (5) influence of inelastic encounters, (6) method of free paths, (7) diffusion and drift in the presence of a steady and uniform magnetic field, (8) motion in hf electric field, (9) experimental methods for measuring electron drift velocities, (10) experimental methods for measuring electron diffusion coefficients, (11) experimental determinations of other electron transport coefficients, (12) cross sectional determinations from electron transport data, and (13) compilation of experimental results and derived cross sections. (MOW)

3112 ELECTRON COLLISION FREQUENCIES AND ENERGY TRANSFER RATES. Mantas, G. P. (Illinois Univ., Urbana). J. Atmos. Terrest. Phys.; 36: No. 10, 1587-1600(Oct 1974).

The rate of energy exchange, through elastic collisions, between two gases with Maxwellian velocity distributions at different temperatures, is derived from elementary considerations. This result is then used to calculate energy transfer rates and collision frequencies for energy transfer in plasmas at thermal disequilibrium. It is found that the electron−ion energy transfer rate and the collision frequency for energy transfer are overestimated by 5 to 37 per cent, depending on the electron density and the electron and ion temperatures, when the classical Coulomb logarithm $\ln \Lambda$ appears in these expressions. A more accurate cross section for Coulomb collisions (than that obtained when the shielded potential is truncated at the Debye length) leads to a correction term for $\ln\Lambda$. Electron−electron and ion−ion collision frequencies and relaxation times differ from the usual expressions for these quantities by as much as a factor of two. Mean experimental and theoretical cross sections for momentum transfer for N_2, O_2, O, He and H are used to obtain simple formulas for collision frequencies and energy transfer rates useful in electron gas temperature calculations. (auth)

3113 NON-THERMAL EQUILIBRIUM PARAMETERS OF WEAKLY IONIZED PLASMAS. Skorupski, A. A.; Suckewer, S. (Inst. of Nuclear Research, Warsaw). J. Phys., B (London); 7: No. 11, 1401-1410(1 Aug 1974).

Generalized Boltzmann and Saha formulae for populations of atomic levels and degree of ionization for a two-temperature plasma in non-thermal equilibrium are given. Inelastic atom-atom type collisions are taken into account. Calculations based on these formulae are performed for optically thin or Lyman series optically thick hydrogen plasmas. They are in good agreement with results obtained by solving the non-linear set of balance equations numerically. In some cases atom-atom collisions change the results by a few orders of magnitude. The radiative source function of the strongly non-LTE and optically thin plasma is determined. It coincides with the Planck distribution for a wide frequency band. (auth)

Production

Refer also to abstracts 3069, 3081, and 3206.

3114 (CLM-L-25) LASERS: THEIR APPLICATIONS AND OPERATIONAL REQUIREMENTS. Spalding, I. J. (UKAEA Research Group, Abingdon. Culham Lab.). 4 Mar 1974. 26p. Dep. NTIS (US Sales Only) $4.50.

Present and potential applications of high-power gas lasers to such diverse areas as industrial systems (alignment, Raman scattering, Doppler velocimeters, materials processing, etc.), isotope-separation, thermonuclear fusion, military applications, etc. are discussed. Different operational characteristics are required for various laser applications, and these are delineated. A brief introduction is given to the general characteristics of gas lasers, and of gas-dynamic, electrical and chemical methods of excitation. (auth)

3115 (COO-2277-1) HIGH BETA CAPTURE AND MIRROR CONFINEMENT OF LASER PRODUCED PLASMAS. Semiannual Report, July 31, 1972–January 31, 1973. Haught, A. F.; Polk, D. H.; Woo, J. T.; Fader, W. J.; Tomlinson, R. G.; Haas, R. A.; Jong, R. A. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). 31 Jan 1973. Contract AT(11-1)-3547. 46p. (UARL-M-921514-18). Dep. NTIS $5.50.

In the UARL Laser Initiated Target Experiment (LITE), magnetically confined, moderate temperature, dense plasmas produced by laser beam irradiation of a small solid particle in vacuum within a minimum-B mirror field are being utilized as the target for a high energy neutral injection beam to examine high-β mirror plasma confinement and the feasibility of neutral injection at high density to produce a hot, dense, steady state, stable, mirror confined plasma. Laser heating of a solid LiH particle electrodynamically suspended in vacuum within the mirror magnetic confinement field initially produces a high density, moderate temperature plasma. Upon expansion, the plasma transverse motion is stopped by the magnetic field, and, by virtue of the high plasma conductivity, the plasma is captured at $\beta = 1$. As the magnetic field subsequently diffuses into the plasma, it undergoes a transition to $\beta \lesssim 1$ mirror confinement. Previous investigations in this program have shown that the resulting plasma can be stably confined in a minimum-B mirror magnetic field, decaying at a rate consistent with Coulomb collisional scattering into the magnetic field mirror loss cones. The investigations currently in progress involve examination of the transition from initial capture with the magnetic field excluded from the plasma volume to $\beta \lesssim 1$ mirror confinement and extension of the earlier confinement results to higher plasma temperatures in the larger volume, higher field, baseball seam, minimum-B magnet coil constructed for the target plasma experiments. In addition, studies are being made of the filling of the mirror confinement region with increased quantities of plasma produced from bigger suspended particles to determine the scaling to larger magnetic field geometries. For the future target plasma experiments, a LiH particle will again be used for the initial laser plasma production. As demonstrated in the earlier studies, the higher charge state of the lithium ions leads to their rapid decay from the confinement region. Upon injection of the energetic neutral hydrogen beam, calculations show that charge exchange collisions replace the moderate energy hydrogen ions of the confined laser produced plasma with the high energy hydrogen atoms from the beam. The charge exchange interaction will result in heating the contained plasma to a temperature determined by the injected beam energy, reducing the Coulomb loss rate. As the plasma decays, Fokker-Planck calculations show that for a sufficiently high beam current and target density a balance is established between the rate of particle input to the plasma by ionization of the injected beam on the target and the losses due to the Coulomb scattering, charge exchange with the cold neutral background, and nonadiabaticity to form a steady state mirror confined plasma. A most attractive feature of the LITE program is that it permits addressing the target plasma questions crucial to the future of open confinement systems with experimental requirements that lie within the current state-of-the-art. (auth)

3116 (SAND-74-5267) DIODE THEORY FOR ELECTRON BEAM FUSION. Freeman, J. R.; Poukey, J. W.; Yonas, G. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 5p. (CONF-741024-1). Dep. NTIS $4.00.

From 2nd international conference on plasma theory; Kiev, USSR (28 Oct 1974).

Pellet heating by intense relativistic electron beams has been proposed as an alternative to the more familiar laser powered pulsed fusion schemes. Focusing of the electron beams onto the target is one of the most important topics in this area. Recent computations of diode focusing using a two-dimensional, finite-size particle simulation method are reported. Results are presented for diodes with open-faced or "hollow" cathodes, a design motivated by diode survivability considerations. Results for diode scaling from 13 cm to 46 cm cathode diameter are presented which indicate that satisfactory focusing can be obtained even at the largest diameters. The modifications of diode focusing caused by the presence of plasma throughout the anode–cathode gap also discussed. (auth)

3117 (SLA-74-5214) LASER PLASMA STUDIES OF SOLID PELLETS IRRADIATED WITH THE SANDIA FOUR-BEAM LASER. Powell, J. E.; Beckner, E. H.; Brannon, P. J.; Cano, G. L.; Cuderman, J. F.; Gilbert, K. M.; Hohlfelder, J. J.; Jones, E. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 4p. (CONF-741105-15). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The Sandia four-beam laser system is being used to study the irradiation and implosion of small solid spheres of CD_2 at laser energies of from 100 to 300 joules. Laser pulse widths of from 1 to 2 nanoseconds are typically employed. The emphasis of these experiments is on correlating the laser input power density (10^{13} to 10^{15} watts/cm^2) with the resulting energy absorption, reflection and pellet compression. Of particular interest are the various plasma instabilities that have been predicted by both analytic theories and computer simulations and their effect upon absorption, reflection, and the generation of hot electrons and superthermal ions. (auth)

3118 BEAM SELF-FOCUSSING IN A LASER-PRODUCED PLASMA IN A MAGNETIC FIELD. Cohn, D. R.; Raff, G. J.; Brooks, R. L.; Loter, N. G.; Halverson, W. (Massachusetts Inst. of Tech., Cambridge (USA). National Magnet Lab.). Phys. Lett., A; 49: No. 2, 95-96(26 Aug 1974).

There has been considerable recent interest in the possible use of CO_2 laser-heated magnetically-confined plasmas for controlled thermonuclear fusion. An important question that must be answered in assessing this approach is whether it is possible for the plasma to act as a dielectric waveguide for the laser radiation. In this letter the first experimental evidence is presented of beam-trapping in a CO_2 laser-induced plasma in the presence of a strong magnetic field, which sharply inhibits the radial plasma flow and would thus be expected to weaken the axial density minimum needed for trapping. (auth)

3119 A CESIUM PLASMA PRODUCED BY COLLISIONS OF THE SECOND KIND $Cs+Hg(6^3P_1) \rightarrow Cs^+ + e + Hg$. Brodskii, V.B.; Voronchev, A.T.; Menakhin, L.P.; Tatarinov, M.A. (Lenin All–Union Electrical Engineering Institute). High Temp. 12: No. 1, 162-164 (Sept 1974).

A cesium plasma layer was produced in a cylindrical quartz cell. The electron concentration and electron temperature distribution in the layer was measured with a probe. (AIP)

3120 STUDY OF AN ELECTRON–BEAM DISCHARGE INTO A VACUUM DIODE WITH POLYETHYLENE ANODE. Kerns, J.R.; Johnson, D.J. (Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico 87117). J. Appl. Phys. 45: No. 12, 5225-5228 (Dec 1974).

A 40–nsec–duration 2.5–MV 25–kA electron–beam discharge into a vacuum diode with polyethylene anode has been studied with time–resolved optical photography and soft x–ray diagnostics. The beam was observed to be initially uniform but to filament at 15 nsec and form a single powerful pinch at 25 nsec. The interaction of the pinched beam and the anode produces a plasma $\leqslant 75$ μm in diameter with a temperature of ~50 eV. Neutron and deuteron emission from the diode were observed and the intensity ratios are consistent with a beam target neutron production mechanism. (auth)

3121 SUPERRADIANT LINE IN THE SOFT–X–RAY RANGE. Jaeglé, P.; Jamelot, G.; Carillon, A.; Sureau, A.; Dhez, P. (Laboratoire de Chimie Physique de l'Université de Paris VI, associé au Centre National de la Recherche Scientifique, Centre Universitaire d'Orsay, 91405—Orsay, France). Phys. Rev. Lett. 33: No. 18, 1070-1073 (28 Oct 1974).

It is shown that the $2p^5 4d\,^3P_1 \rightarrow 2p^6\,^1S_0$ line of the Al^{3+} ion at a wavelength of 117.41 Å is superradiant in a dense laser—produced plasma. The measured gain in a two—plasma experiment is 17%. The gain coefficient is of the order of 10 cm^{-1} with a lower limit of 2.5 cm^{-1} and an upper limit of 22 cm^{-1}. (auth)

3122 HOT—SPOT MODEL OF K—LINE EMISSION FROM LASER—HEATED PLASMAS. Whitney, K.G. (Science Applications, Incorporated, McLean, Virginia 22101); Davis, J. J. Appl. Phys. 45: No. 12, 5294-5302 (Dec 1974).

A nonhydrodynamic model is developed to describe x—ray emission from laser—heated plasmas on a subnanosecond time scale. The model is first correlated with the experiment and then is used to study the conversion efficiency of laser energy to K—line x rays in carbon, fluorine, and aluminum plasmas as a function of incident laser intensity. It is found that these conversion efficiencies peak at well—defined values of input energy per area for laser pulse widths smaller than the pumping times for K—line emission. In this case, the degree and not the rate of plasma heating is important in determining the peak conversion efficiency. It is also found that peak conversion to K radiation in excess of roughly 10 or 20% occurs only when the C, F, and Al plasmas are optically thick to the K_α lines. (auth)

Stability

Refer also to abstracts 3159 and 3177.

3123 (AD-772533) PARAMETRIC INSTABILITIES INDUCED BY THE COUPLING OF HIGH AND LOW FREQUENCY PLASMA MODES. Manheimer, W. M.; Ott, E. (Naval Research Lab., Washington, D. C. (USA)). Dec 1973. 40p. (NRL-MR-2685). NTIS $5.00.

A general dispersion relation is derived for parametric instabilities caused by a large amplitude pump wave which couples high and low frequency modes of a magnetized plasma. The nonlinear effects coupling the high and low frequency waves are: (1) the low-frequency pondermotive force due to the coupling of the pump with the high frequency perturbations, and (2) the high frequency nonlinear source current density produced by coupling of the pump with the low frequency perturbations. The dispersion relation contains decay instabilities, purely growing instabilities, modulational instabilities, self-focusing, and nonlinear Landau damping. As examples the authors apply the dispersion relation to self-focusing, magnetosonic decay and purely growing instabilities, whistler decay and nonlinear Landau damping of electron plasma waves and transverse electromagnetic waves. (auth)

3124 (AD-777270) STUDIES IN STABILITY AND CONTROL OF HIGH-TEMPERATURE PLASMAS. Final Report, 1 May 1972—31 December 1973. Wang, P. K. C. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Feb 1974. 352p. (UCLA-ENG-7403; AFOSR-TR-74-0462). NTIS $8.00.

The objective of the study is to develop applicable theories for the stabilization and control of high-temperature plasmas taking into consideration various physical constraints and nonlinear effects. The main results include the development of a theory for the feedback stabilization of highly-conducting nonlinear plasmas. A summary of the results is given first. The technical details are given in the appendices. (auth)

3125 (AD-777716) NONLINEAR STABILIZATION OF BEAM PLASMA INSTABILITIES. Papadopoulos, K. (Naval Research Lab., Washington, D. C. (USA)). Mar 1974. 35p. (NRL-MR-2749). NTIS $3.25.

The effect of parametric instabilities induced by waves produced in the kinetic stage of beam—plasma interactions was investigated. It was found that within a definite range of plasma parameters the oscillating two-stream instability (OTS) is capable of stabilizing the beam—plasma instability at a level substantially lower than the one predicted by quasi-linear theory. This occurs because at a certain level of beam generated waves the transfer of wave energy outside the spectral region in resonance with the beam by the OTS is faster than the instability growth. The consequences of this nonlinear stabilization with respect to the efficiency of plasma heating in the laboratory and with respect to phenomena observed in the auroras and the Type III radiobursts are presented. (auth)

3126 (AD-778666) HYDRODYNAMIC STABILITY OF A ROTATING LINER. Barcilon, A.; Book, D. L.; Cooper, A. L. (Naval Research Lab., Washington, D. C. (USA)). Apr 1974. 49p. (NRL-MR-2776). NTIS $3.25.

The Rayleigh-Taylor instability was investigated for a nonsteady basic state. A model of a magnetically imploded cylindrical metallic liner compressing an axial magnetic field was constructed and used as the basis of a linear stability analysis. The liner, idealized to be without energy loss mechanisms, can be given an initial rotation about its axis. Analytic and numerical techniques were used to study the stability of flute-like irrotational perturbations about this state. Stability was quantified in terms of the tendency of the liner to disrupt or to encroach toward the axis, and is determined as a function of mode number M, the form of initial disturbance, liner thickness and the amount of rotation. It is shown that thickening the liner tends to stabilize against both encroachment and disruption, while increasing rotational velocity tends to stabilize against encroachment. (auth)

3127 (CONF-741105-25) STUDY OF MAGNETOHYDRODYNAMIC MODES IN TOKAMAK CONFIGURATIONS WITH NONCIRCULAR CROSS SECTIONS. Chance, M. S.; Dewar, R. L.; Glasser, A. H.; Greene, J. M.; Grimm, R. C.; Jardin, S. C.; Johnson, J. L.; Rosen, B.; Sheffield, G. V.; Weimer, K. E. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1974. Contract AT(11-1)-3073. 3p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Present interest in tokamaks with noncircular cross sections motivates study of the magnetohydrodynamic stability properties of general axisymmetric configurations. Some of the results of such a program are reported. The problem is divided into two parts: (1) the determination of equilibrium configurations and evaluation of stability criteria for localized modes, and (2) the study of the complete normal mode spectrum of the configuration. (MOW)

3128 (CONF-741105-26) LINEAR AND NONLINEAR ASPECTS OF DISSIPATIVE TRAPPED-ION AND TRAPPED-ELECTRON MODES. Berk, H. L.; Frieman, E. A.; LaQuey, R. E.; Lovelace, R. V.; Mahajan, S. M.; Rosenbluth, M. N.; Rutherford, P. H.; Tang, W. M. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1974. 3p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Three topics are discussed: two distinct nonlinear effects on the dissipative trapped-ion mode, namely nonlinear E × B motions, and anomalous scattering due to the development of an unstable loss-cone-type ion distribution function; a revised analysis of the linear eigenmodes of the dissipative trapped-electron instability, leading to a qualitatively different picture of the effect of magnetic shear. (auth)

3129 (COO-3497-10) ANNUAL PROGRESS REPORT. Simon, A. (Rochester Univ., N. Y. (USA)). 16 Sep 1974. Contract AT(11-1)-3497. 12p. Dep. NTIS $4.00.

This contract has concentrated on nonlinear and linear theory of instabilities in finite plasma for purposes of comparison with actual experiment whenever possible. Emphasis has been on nonlinear threshold saturation calculations, in order to establish the mechanisms responsible for saturation of instabilities and to identify the instability in one of its most commonly observed states. A number of fluid instabilities, collisionless, collisional or weakly ionized, have previously been treated this way. An equivalent analysis was performed for an instability governed by the Vlasov equation; the collisionless drift. The saturation mechanism appears to be ion heating. As a preliminary to this work, it was necessary to extend linear theory of the collisionless drift in sheared fields to include both finite boundaries and radial variation of the potential. A set of useful "universal" stability boundaries is obtained. A calculation was obtained for the stability criteria for sheared plasma with localized modes. Finally, a general theory of linear stability boundaries for hot plasma in mirror machines, in the presence of both density and temperature gradients, was obtained. (auth)

3130 (LA-5717-MS) MULTIPLE TIME SCALE PERTURBATION FOR TWO FREQUENCY NONLINEAR TAYLOR INSTABILITY. White, G. N. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1974. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

The nonlinear interaction of two Taylor unstable waves of different initial amplitude and frequency is studied by means of a multiple time scale perturbation. Unlike the single time scale expansion, the multiple scale treatment shows, explicitly, a dependence of the growth rate on the initial amplitudes and frequencies and confirms the early growth rate dependency found in numerical calculations (White, 1974). (auth)

3131 (LA-UR-74-1446) MHD STABILITY OF THE SCYLLAC CONFIGURATION. Berge, G.; Freidberg, J. P. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 13p. (CONF-741105-19). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The results of a stability analysis for a diffuse high β, l = 1 helical configuration are presented. It is shown that there exists a gross m = 1 mode whose properties are quite similar to those predicted by the sharp boundary model. In addition, two new classes of m = 1 modes are found, one localized on the inside of the plasma, the other on the outside. For any monotonic pressure profile these modes are unstable although their growth rates are very small. A further study suggests that small changes in the profile may stabilize these modes. (auth)

3132 (LA-UR-74-1447) STABILITY OF KINK MODES IN HIGH BETA TOKAMAKS. Freidberg, J. P.; Goedbloed, J. P.; Grossmann, W.; Haas, F. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 17p. (CONF-741105-20). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

MHD stability calculations of high $\beta \sim a/R$ tokamak configurations are given for three separate classes of equilibria viz. (1) thin skin sharp boundary model, (2) quasi-uniform current model, and (3) diffuse profile model. (auth)

3133 (LA-UR-74-1520) PLASMA PARAMETERS AND STABILITY OF THE ZT-1 PINCH EXPERIMENT. Baker, D. A.; Burkhardt, L. C.; Di Marco, J. N.; Forman, P. R.; Haberstich, A.; Howell, R. B.; Karr, H. J.; Phillips, J. A.; Schofield, A. E. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 12p. (CONF-741105-27). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The ZT-1 toroidal z-pinch experiment is designed to produce theoretically predicted MHD stable equilibria with high temperature plasmas. The equilibria are characterized by a hollow pressure profile and a strong toroidal stabilizing field inside the plasma; this field is programmed to reverse in the outermost region of the pinch. Experiments have been done with pinch current values of 30 to 200 kA with rise times of 2×10^{10} to 1.5×10^{12} A/s. Ion temperature measurements have established the capability of a fast rising toroidal current to heat ions to kilovolt temperatures. The streak pictures, plasma density and magnetic field measurements show that, for intermediate values of current rise times, the plasma is well confined, with small particle loss, for 10 to 12 μs. For this mode of operation measurements on the plasma and field parameters show that appropriate field programming eliminates early unstable behavior. The rise times of the poloidal and reversed toroidal fields need to be comparable in order to achieve the desired stable profiles. The electrons are observed to be colder than the ions and the measurements indicate that the stable time is limited by field diffusion. (auth)

3134 (UCID-16615) CURRENT-STABILIZATION OF THE CURVATURE-DRIVEN m = 1 MODE. Logan, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Oct 1974. Contract W-7405-eng-48. 20p. Dep. NTIS $4.00.

A short review is given of the m = 1 mode instability of long, thin, high-beta plasma columns in axisymmetric mirror fields, followed by a δW calculation of the magnitude of longitudinal plasma current required to stabilize the curvature-driven instability by the image currents returning in a conducting wall. The parameter regimes explored are those useful for proposed two-component mirror fusion reactors and multiple-mirror reactors. The possible excitation of current-driven helical modes and their suppression by alternating the current is then discussed. (auth)

3135 (UCRL-75522) COMPUTATIONAL STUDIES OF TWO-COMPONENT MIRROR REACTORS. Byers, J. A.; Freis, R. P.; Killeen, J.; Lee, E. P.; McNamara, B.; Mirin, A. A.; Rensink, M. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Sep 1974. 16p. (CONF-741105-16). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

An extensive study was made of the energetics, equilibrium, and stability of two-component mirror systems. Collisional target plasmas are described by equilibrium fluid flow equations in the Marteni computer code. The Marteni code is coupled to a particle simulation code for application to an arc target plasma. The particle code determines the net transfer of directed beam energy to the plasma (typically 10 to 15% maximum) and this produces input for the power balance of the Marteni code that determines T_e. For two-component systems supported by neutral injection, the Marteni code is coupled to Fokker–Planck (MFP) codes that describe the collisional decay of the injected species. A radial transport code that gives information on the trapping fraction of the neutral beam and on volume erosion of the target plasma is included. In the simplest cases the codes produce predictions of T_e that are a factor of 2 to 3 lower than previous estimates. Self-consistent magnetic field effects are calculated with a particle simulation code that shows long-lived reversed field configurations are possible. The MFP codes predict that velocity space instabilities are definitely present during the buildup phase, will occur even in the steady state for low mirror ratios, $R \approx 2$, and can possibly be stabilized by high mirror ratios $R \gtrsim 10$. Particle simulation codes predict a spreading of the hot ion energy spectrum. (auth)

3136 (UCRL-75992) STABILIZING MECHANISMS FOR LOSS-CONE MODES. Baldwin, D. E.; Berk, H. L.; Pearlstein, L. D.; Kammash, T.; Uckan, T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Sep 1974. 16p. (CONF-741105-13). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

An investigation was made of various mechanisms that might be responsible for the apparent absence of the theoretically predicted drift-cyclotron-loss-cone mode in high density mirror machines when $\omega_{pe}^2 \sim \omega_{ce}^2$. Warm plasma outside the trap at 2XII parameters is found to affect the mode only weakly. Fanning of the magnetic field is found to stabilize modes sharply resonant in $k_\perp$, such as Dory–Guest–Harris, but not to affect instabilities with broad spectra. Also investigated is the possibility of electron orbit diffusion due to the presence of a suggested high-frequency electron instability. Stabilization by this means would explain a number of experimentally observed properties; however, the nonlinear picture is incomplete as discussed. The standard one-dimensional, absolute instability criterion is extended to two dimensions and effects of finite $m_e/m_i < \beta \ll 1$ are included. At ion energies spanning present experimental conditions to reactor conditions, one finds only a weak shift in the instability threshold densities. (auth)

3137 FAST-ELECTRON CURRENT OSCILLATIONS IN THE CASE OF PARAMETRIC INSTABILITY IN A PLASMA LAYER. Batanov, G. M.; Silin, V. A. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 10, 323-324(20 May 1974).

Translated from Zh. Eksp. Theor. Fiz., Pis'ma Red.; 19: No. 10, 621-624(20 May 1974).

The oscillations of the current of fast electrons produced when a microwave is incident on a plasma layer were studied. The increased excess above threshold changes the oscillation frequency from 22 to 4 MHz. The phenomenon is explained on the basis of the premises of the nonstationary theory of Langmuir turbulence. (auth)

3138 HYDRODYNAMIC STABILITY OF A LASER–DRIVEN PLASMA. Brueckner, K.A.; Jorna, S.; Janda, R. (KMS Fusion, Inc., Ann Arbor, Michigan 48106). Phys. Fluids 17: No. 8, 1554-1559 (Aug 1974).

The hydrodynamical stability of a laser–driven plasma is investigated by analytically and numerically solving the set of coupled conservation equations of hydrodynamics to first order. The calculations are illustrated by a series of graphs showing the time evolution of the state variables of a laser–driven deuterium–tritium fusion plasma. (auth)

3139 PARAMETRICALLY EXCITED INSTABILITIES NEAR THE HYBRID RESONANT FREQUENCIES. Seshadri, S.R. (Department of Electrical and Computer Engineering, The University of Wisconsin, Madison, Wisconsin 53706). J. Appl. Phys. 45: No. 11, 4826-4834 (Nov 1974).

The parametric excitation of the ordinary mode and the extraordinary mode propagating perpendicular to the magnetostatic field is investigated for the case of a cold uniform plasma. The pump wave is assumed to be another ordinary mode having its electric field oriented parallel to the magnetostatic field and its frequency exceeding the plasma frequency of the electrons. The extraordinary mode has three branches, namely, a high–frequency branch, an intermediate–frequency branch having a resonance at the upper hybrid resonant frequency, and a low–frequency branch which in the regime of hydromagnetic frequencies is the Alfvén wave and which also has a resonance at the lower hybrid resonant frequency. The ordinary mode does not parametrically couple with the high–frequency branch of the extraordinary mode but such a coupling takes place with the other two branches. This parametric coupling leads to instabilities of the extraordinary mode. Illustrative numerical results are presented for the parametric instabilities of the extraordinary mode near the upper hybrid resonant frequency, the lower hybrid resonant frequency, and the Alfvén wave frequency. Compared to the intermediate–frequency branch, the requirements for the parametric interaction are found to be met easily for the low–frequency branch. The dependence of the maximum growth rates of the parametric instabilities on the strength of the magnetostatic field is also examined. (auth)

3140 SATURATION OF BEAM–PLASMA INSTABILITY IN A LOSSY PLASMA. Carr, W.; Jones, R.; Boyd, D.; Manickam, J.; Seidl, M. (Department of Physics, Stevens Institute of Technology, Hoboken, New Jersey). Phys. Fluids 17: No. 8, 1638-1639 (Aug 1974).

For the beam–plasma instability with $\omega > \omega_{ce}$ in the limit of a cold, weak beam effective energy transfer to the plasma is observed. This is found to agree with the one–dimensional beam trapping calculation when linear cyclotron damping is included. (auth)

3141 CONNECTION BETWEEN THE LINEAR AND NONLINEAR THEORY OF ANOMALOUS REFLECTION FROM A PLASMA SLAB. Manheimer, W.M. (Naval Research Laboratory, Washington, D.C. 20375). Phys. Fluids 17: No. 8, 1634-1635 (Aug 1974).

It is shown that the threshold for absolute backscatter linear instability is the same as the threshold for nonlinear steady state reflection in a plasma slab. (auth)

3142 SYNCHRONOUS QUENCHING OF DRIFT–WAVE INSTABILITY. Odajima, K.; Nishida, Y.; Hatta, Y. (Department of Electronic Engineering, Tohoku University, Sendai, Japan). Phys. Fluids 17: No. 8, 1631-1633 (Aug 1974).

Synchronous quenching of drift–wave instability is investigated experimentally. The measurements show resonance phenomena similar to that of ion–sound instability. The result is quantitatively compared with a phenomenological theory which includes a linear growth and a nonlinear saturation source term. (auth)

3143 EFFECTS OF FINITE–BANDWIDTH DRIVER ON THE PARAMETRIC INSTABILITY. Thomson, J.J.; Karush, J.I. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 17: No. 8, 1608-1613 (Aug 1974).

A set of model equations for the parametric instability that consist of damped harmonic oscillators coupled with a stochastic oscillatory driver is considered. With the assumption that the autocorrelation time of the stochastic part of the driver is very short, a solution for the average response of the oscillators is derived. This solution holds for arbitrary damping rates, unlike the results of previous authors. Threshold levels and growth rates for the parametric decay oscillating two–stream instabilities are found as a function of driver bandwidth. (auth)

3144 STABILIZATION OF AN IONIZATION INSTABILITY BY A HIGH–FREQUENCY ELECTRIC FIELD. Andropov, V.G.; Sinkevich, O.A. (High–Temperature Institute, Academy of Sciences of the USSR). High Temp. 12: No. 1, 1-4 (Sept 1974).

It is shown that the ionization instability developing in a weakly ionized, nonequilibrium magnetized plasma can be suppressed by applying an additional hf electric field perpendicular to the constant electric and magnetic fields when Joule heating by the constant electric field is equal to Joule heating by the hf electric field. If only a hf electric field is present, the ionization instability develops at practically all frequencies of the latter. (auth)

3145 EFFECT OF AN ADMIXTURE OF NITROGEN ON ELECTRON DENSITY AND IONIZATION INSTABILITY OF AN ALKALI METAL VAPOR PLASMA. Kruzhilin, N.A.; Mnatsakanyan, A.K. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 12: No. 1, 21-25 (Sept 1974).

The electron density in an alkali metal vapor plasma containing an admixture of nitrogen molecules was investigated in relation to the atom density. Alkali metal atoms significantly affect the vibrational temperature. A satisfactory agreement with experimental data for a discharge in a mixture of argon, nitrogen, and cesium is obtained. Ionization instability is discussed. (auth)

3146 RELAXATION OF A PARAMETRIC TURBULENCE IN A PLASMA. Andreev, N.E.; Pustovalov, V.V.; Silin, V.P.; Tikhonchuk, V.T. (P.N. Lebedev Physics Institute, USSR Academy of Sciences). Sov. J. Quantum Electron. 4: No. 5, 600-606 (Nov 1974).

A theoretical (analytic and numerical) study is made of a nonstationary (transient) plasma turbulence initiated by a parametric instability involving decay of a pump wave into two plasmons and saturated by the stimulated scattering of plasmons on ions. The main features of the relaxation of such a parametric turbulence are governed by the characteristics of the noise saturation mechanism and are in this sense typical of many other instabilities which can be stabilized by stimulated scattering. A solution of a nonlinear integro–differential equation for the spectral density of the noise energy reveals the complete evolution pattern of the appearance and growth of a turbulent noise, which oscillates in time, has a modulated spectrum, and finally attains a smooth stationary (steady–state) distribution. A nonstationary parametric turbulence can develop fully in a dense laser plasma during a nanosecond pulse emitted by a high–power neodymium laser. (auth)

3147 PONDEROMOTIVE–FORCE EFFECTS IN A NONUNIFORM PLASMA. Morales, G.J.; Lee, Y.C. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. Lett. 33: No. 17, 1016-1019 (21 Oct 1974).

The effect of the ponderomotive force in the interaction of a capacitor rf field with a nonuniform plasma is investigated. (auth)

3148 PARAMETRIC INSTABILITIES IN FINITE INHOMOGENEOUS MEDIA. DuBois, D.F.; Forslund, D.W. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544); Williams, E.A. Phys. Rev. Lett. 33: No. 17, 1013-1016 (21 Oct 1974).

The general first–order parametric–instability equations for an inhomogeneous finite–size plasma are solved both analytically and numerically. It is shown that the wave–number mismatch introduced by plasma gradients does not necessarily convert absolute instability into convective instability, even for large systems. Absolute instability can also occur when the length of the system is determined by a smooth spatial dependence of the growth rate. (auth)

3149 CROSS–FIELD CURRENT–DRIVEN MODIFIED ION–CYCLOTRON INSTABILITY IN AN INHOMOGENEOUS MAGNETOPLASMA. Yatsui, K.; Irie, T.; Furumi, M.; Imai, T.; Yatsuzuka, M. (Department of Electrical Engineering, Osaka University, Toyonaka, Osaka 560, Japan). Appl. Phys. Lett. 25: No. 11, 637-638 (1 Dec 1974).

The low–frequency interaction of a cross–field current with a longitudinally magnetized inhomogeneous plasma has been studied. It is found experimentally that, in addition to the ion–cyclotron harmonic instability, a very low–frequency instability also develops in the range $\omega^2 < \omega_{ci}^2$, ω_{ci} being the ion–cyclotron frequency, and that at these large amplitudes nonlinear wave mixing takes place between them. Using a simple model, we show that the latter mode can be interpreted in terms of the cross–field current–driven modified ion–cyclotron instability. (auth)

3150 IDENTIFICATION OF ION–CYCLOTRON DRIFT INSTABILITY WITH DISCRETE AND CONTINUOUS SPECTRA. Hendel, H.W.; Yamada, M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 33: No. 18, 1076-1079 (28 Oct 1974).

Ion–cyclotron drift waves with discrete and continuous spectra are identified by measurements of ω and $\vec{k}$ and explained by a theory which includes parallel electron current. This instability has a spectrum and effects on the plasma similar to those of ion sound, and can exist in plasmas which are ion–sound stable. (auth)

3151 SPATIAL DAMPING OF WHISTLER WAVES IN PLASMAS. Ohkubo, K.; Tanaka, S. (Kyoto Univ.). J. Phys. Soc. Jap.; 36: No. 3, 843–851(Mar 1974).

The dispersion and spatial damping of whistler waves propagating in plasma columns having relatively high electron density and moderate electron temperature are investigated theoretically and experimentally. In collisionless hot plasmas, the damping rate k_1, wave number k_r and the ratio k_1/k_r as functions of frequency ω are derived in the vicinity of the cyclotron resonance. When the effects of collisions become significant, the above quantities are corrected by including the collision frequency ν appropriately. Near the resonance, k_1/k_r equal to the sum of the cyclotron damping term and the collisional damping term which is proportional to ν/ω_c. The observed dispersion curves agree well with those in collisional hot-plasma theory. The observed damping rate is due to the cyclotron damping plus Coulomb collisional damping in moderate T_e plasmas, while it is ascribed totally to Coulomb collisions in low T_e plasma. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 4081 and 4088.

3152 (BNWL-SA-4932) PROGRESS TOWARD THE DEVELOPMENT OF A MIRROR HYBRID (FUSION-FISSION) REACTOR. Leonard, B. R. Jr.; Wolkenhauer, W. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 12p. (CONF-741105-21). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Pacific Northwest Laboratories (PNL), in cooperation with Lawrence Livermore Laboratory, has been studying a hybrid (fission-fusion) reactor based on a mirror magnetic confinement device. The fissile blanket concept, based on a depleted uranium convertor and a slightly enriched uranium High Temperature Gas Cooled Reactor technology, has been developed at PNL. Using the

DT plasma constraints and systems analysis primarily performed at LLL, the results of initial condition neutronics calculations were previously reported. These results projected a viable electrical power plant with 2000 MW(th) developed in the blanket, 680 MW(e) net, and probable breeding of both thermally fissile material and tritium in a subcritical fission blanket. The results of neutronics calculations performed through a 200 day operating period are described. These results confirm the performance characteristics originally proposed and, in fact, predict a larger average blanket energy multiplication and more positive fissile and tritium breeding over the operating period. The calculations also demonstrate the necessity of performing calculations during burnup, at operating temperature, to obtain reliable performance parameters. In addition, a minor design change, the sensitivity of the calculated performance to ^{238}U data deficiencies, and a preliminary assessment of the importance of the broad source neutron energy spectrum of the mirror in the neutronics analysis are discussed. (auth)

3153 (BNWL-SA-5069) INTERESTING POSSIBILITIES OF FUSION–FISSION. Werner, R. W.; Lee, J. D.; Moir, R. W.; Carlson, G. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 5p. (CONF-741105-2). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

In a world economy highly sensitive to increasing energy demands, it is vital to investigate all viable combinations of energy producing methods. The fusion-fission hybrid is such a combination. The ultimate "pure" fusion reactor is recognized but it is contended that a step along the way may be fusion-fission. It may decrease the time to a demonstration reactor since the plasma characteristics necessary to achieve fusion-fission are significantly less than those for pure fusion power. (auth)

3154 (CONF-740807-3) TRITIUM RECOVERY AND SEPARATION FROM CTR PLASMA EXHAUSTS AND SECONDARY CONTAINMENT ATMOSPHERES. Forrester III, R. C.; Watson, J. S. (Oak Ridge National Lab., Tenn. (USA)). 1974. 11p. Dep. NTIS $4.00.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

Recent experimental successes have generated increased interest in the development of thermonuclear reactors as power sources for the future. This paper examines tritium containment problems posed by an operating CTR and sets forth some processing schemes currently being evaluated at the Oak Ridge National Laboratory. An appreciation of the CTR tritium management problem can best be realized by recalling that tritium production rates for various fission reactors range from 2×10^4 to 9×10^5 Ci/yr per 1000 MW(e). Present estimates of tritium production in a CTR blanket exceed 10^9 Ci/yr for the same level of power generation, and tritium process systems may handle 10 to 20 times that amount. Tritium's high permeability through most materials of construction at high temperatures makes secondary containment mandatory for most piping. Processing of these containment atmospheres will probably involve conversion of the tritium to a nonpermeating form (T_2O) followed by trapping on conventional beds of desiccant material. In a similar fashion, all purge streams and process fluid vent gases will be subjected to tritium recovery prior to atmospheric release. Two tritium process systems will be required, one to recover tritium produced by breeding in the blanket and another to recover unburned tritium in the plasma exhaust. Plasma exhaust processing will be unconventional since the exhaust gas pressure will lie between 10^{-3} and 10^{-6} torr. Treatment of this gas stream will entail the removal of small quantities of protium and helium from a much larger deuterium-tritium mixture which will be recycled. (auth)

3155 (CONF-741017-21) FIRST WALL BUMPER CONCEPTS. Coultas, T. A. (Argonne National Lab., Ill. (USA)). 1974. 16p. Dep. NTIS $4.00.

From meeting of the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

The theta-pinch FERF conceptual design uses a radiation cooled "bumper" to protect the implosion heating coil from thermal cycling. This concept of a plasma chamber liner is also used in other conceptual designs of fusion reactors and research facilities. The Princeton Tokamak design uses a helium cooled "radiation shield." The LLL FERF concept uses a water-cooled "sacrificial structure." These concepts were designed to handle relatively high heat fluxes at the first wall. Conceptual designs with considerable lower first wall loading have not used such a shield. In the theta-pinch FERF however, the first wall loading is low (0.75 MW/m^2), but other considerations made first wall protection desirable. Apparent advantages of the concept include: increased design flexibility and reliability, decreased thermal stresses, outgassing and pumping requirements and the bumper does not need to be a vacuum wall. Disadvantages may include: interference with the plasma cycle, plasma contamination and, if convectively cooled, an additional cooling circuit. These facets and the possibility of the use of a conductively cooled bumper are discussed here. (auth)

3156 (CONF-741019-4) HIGH INTENSITY ION SOURCE FOR THERMONUCLEAR RESEARCH AND DEVELOPMENT. Morgan, O. B. (Oak Ridge National Lab., Tenn. (USA)). 1974. 26p. Dep. NTIS $4.50.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

A discussion is given of recent ion source developments in the US that have resulted in the availability of 10's of amperes of hydrogen ion beams at energies of 10's of keV and with total energies up to 10's of kJ that can be utilized for creating hot, confined plasmas in magnetic devices. The present status of this thermonuclear development program is discussed along with some of the future plans and possible alternatives for accomplishing some very challenging goals. (MOW)

3157 (CONF-741019-5) EXTRACTION SYSTEM DESIGN FOR A 50A, 50 keV, 2 SEC ION BEAM. Stewart, L. D.; Davis, R. C.; Jernigan, T. C.; Morgan, O. B.; Schechter, D. E.; Stirling, W. L. (Oak Ridge National Lab., Tenn. (USA)). 1974. 4p. Dep. NTIS $4.00.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

The basic ORMAK injection unit was operated at 40 keV, 6A, 0.3 sec and a 15% duty cycle, while monitoring power loading to the various extraction system electrodes, in order to pinpoint the critical power loading areas. A 40A scaleup of this ORMAK unit is being built. Thermal time constants for these water-cooled extraction electrodes are about 0.5 sec. Going from 0.3 to 2 sec will therefore increase the power loading. An increase in beam energy above 40 keV will also increase the loading. ORMAK unit data indicate that the ground electrode and the plasma-forming electrode have relatively high power loadings. For the 40 keV, 6A operation these were 400 watts per cm^2 of Cu extraction surface and 200 watts per cm^2 respectively. The extraction electrode loading was relatively small, 40 watts per cm^2. These loadings and their variation with system parameters indicate that the ground electrode loading is due to direct interception, extraction electrode loading is due to ions formed by beam–gas interactions in the gap, and plasma-electrode loading is due principally to secondary electrons from the extraction electrode. Ground electrode loadings will be reduced as a result of studies including single beamlet optics, electrode thickness and gap variations, hole size and shape variations, and possible current density reductions. Plasma-electrode loadings will be reduced as a result of studies including electrode material and coating variations, and possible reductions in current density and gap pressure. (auth)

3158 (CONF-741019-6) PLASMA PROPERTIES AND PERFORMANCE OF THE 10 CM DUOPIGATRON ION SOURCE. Stirling, W. L.; Davis, R. C.; Jernigan, T. C.; Morgan, O. B.; Ryan, P. M.; Schechter, D. E.; Stewart, L. D. (Oak Ridge National Lab., Tenn. (USA)). 1974. 12p. Dep. NTIS $4.00.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

A scaled-up version of the 7 cm DuoPIGatron has been built and investigation of plasma properties is continuing. Density scans of the 10 cm or scaled-up version show a uniformity of ±20% over a 5 cm radius which is slightly better than the ±30 to ±35% achieved in the 7 cm source over a 3.5 cm radius. Preliminary rf measurements indicate the presence of a helical instability in agreement with that found in the 5 cm DuoPIGatron. Hydrogen ion beams have been extracted from the source at 20 kV using a 7 cm grid pattern which has 209 apertures of 0.150 inches ID and at 25 kV using a 10 cm grid pattern with 365 apertures of the same size. Up to 7A has been extracted at 20 kV; however, the target power peaks at a current drain of 4 to 5A. About 45% of the power is deposited on a 10 cm diameter target 125 cm from the source grids. The high voltage is electronically regulated and operation is very steady and reliable. Up to 9A have been extracted at 25 kV with an unregulated supply. High voltage arcing is a more serious problem in this operation and is believed to be due to the large variation in grid voltage due to the pulsed load. (auth)

3159 (CONF-741105-1) ELMO BUMPY TORUS (EBT) EXPERIMENTS. Dandl, R. A.; Eason, H. O.; England, A. C.; Ikegami, H. (Oak Ridge National Lab., Tenn. (USA)). 1974. 8p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The problem of instabilities in the ELMO Bumpy Torus (EBT) is reviewed. Plasma confinement time of EBT in a collisionless neoclassical regime is described. Plasma electron density and temperature measurements were performed by microwave interferometry and Langmuir probes. Future research areas are outlined. (MOW)

3160 (CONF-741105-23) FUSION DYNAMICS OF LOSSY REACTOR SYSTEMS AND POWER BALANCE IMPLICATIONS. McNally, J. R. Jr.; Clarke, J. F.; Fowler, R. H.; Hiraoka, T.; Sharp, R. D.; Steiner, D. (Oak Ridge National Lab., Tenn. (USA)). 1974. 17p. (CN-33/G-1-3). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Nuclear fusion reactivity calculations are reported for zero-dimensional, magnetically confined, lossy reactor systems after the methodology of Etzweiler, Clarke and Fowler. These systems are radiation damped, dissipative-trapped-particle-loss-mode dominated DT fueled tokamak reactors. Injection of a mixed energetic neutral beam of D^0 and T^0 at E_0 = 300 keV heats the plasma to ignition following which a thermal runaway occurs until the increasingly severe dissipative trapped ion losses lead to a plasma "blow-out" phenomenon. The blow-out process is identified with the use of too high an injection energy. Reduction of the fuel injection energy below the instability value permits steady state reactor operation at high Q_η (= P_{out}/P_{in}). A steady state tokamak can operate, in principle, at E_0' = 25 keV after ignition with E_0 = 300 keV neutrals with a Q_η of 22. The temperature perturbation of such a steady state reactor leads to a negative temperature coefficient; source perturbations give a positive density coefficient which must be carefully controlled to prevent excessive wall loading; magnetic field perturbations give a positive field coefficient which would permit positive feedback control on the reactivity. The power balance implications are assessed on the following assumptions: (1) the neutral beam injectors have an efficiency of 70%. (2) The pulsed magnetic field energy is supplied by a superconducting magnetic energy storage and transfer system having an efficiency of 90% and approximately 80% of the pulsed magnetic energy is recovered at the end of each cycle. (3) The efficiency of the thermal conversion system is 40%. With these assumptions, a Q_η of about 14 is required in order to achieve net power production with an overall plant efficiency of 30%. In order to achieve power break-even, a Q_η of about 3 is necessary. (auth)

3161 (CONF-741105-24) TWO-ENERGY-COMPONENT TOROIDAL FUSION DEVICES. Berk, H. L.; Furth, H. P.; Jassby, D. L.; Kulsrud, R. M.; Liu, C. S.; Rosenbluth, M. N.; Rutherford, P. H.; Johnson, T.; Killeen, J.; Mirin, A. A.; Rensik, M. E. (Princeton Univ., N. J. (USA). Plasma Physics Lab.; California Univ., Livermore (USA). Lawrence Livermore Lab.). 1974. Contract AT(11-1)-3073. 3p. Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Studies designed to lay the foundation for the practical implementation of the two-component reactor concept are listed as follows: (1) Slowing-Down. One and two-dimensional multi-species Fokker–Planck computations are being used to obtain the ion distribution functions in energy (and pitch angle). (2) Power Production. Power multiplication factors Q are calculated for the distribution functions for various D-T mixtures. (3) Gross Equilibrium. The toroidal equilibrium of a two-component tokamak plasma is obtained from a spatially two-dimensional code. (4) Stability. The velocity-space stability of various distribution functions is examined, employing analytical solutions for the steady-state distribution functions, as well as computational results. (5) Confinement. A time-dependent radial transport code is used to follow the evolution of specific models of beam-injected tokamak plasmas. The effects of impurities, neutral gas, and various instabilities are included. The attainment of break-even is calculated for illustrative tokamak devices in the 1-MA range. (MOW)

3162 (COO-2319-11) CORNELL RELATIVISTIC ELECTRON COIL EXPERIMENT (RECE) UNDER JOINT ESEERCO–USAEC: SPONSORSHIP. Technical Progress Report, July 1, 1973–March 31, 1974. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Plasma Studies). 1974. Contract AT(11-1)-2319. 60p. Dep. NTIS $6.00.

During the nine months of this report period, a number of experimental and theoretical results were obtained by the Cornell RECE-program which all give favorable indications concerning the usefulness of high-energy charged particle coils for a final fusion reactor. In particular, additional positive evidence was collected concerning the question of gross stability of the rings. It appears that, contrary to many opinions, this question may not constitute a major obstacle against the application of such internal particle coils. Among other results, clear field-reversal has been achieved very recently with RECE-Christa. At least equally important, experiments with "Ioffe" windings added to the magnetic field coils of RECE-Berta may have opened the way to generate the necessary ion rings considerably cheaper than had been assumed possible so far. Finally, an overall systems analysis performed for a particular fusion scheme based on such charged particle coils indicates considerable economic advantages when compared with the more conventional schemes. (auth)

3163 (COO-2319-12) RECENT PROGRESS IN THE EXPERIMENTAL STUDIES OF RELATIVISTIC ELECTRON COILS. Annual Progress Report, September 1973–September 1974. (Cornell Univ., Ithaca, N. Y. (USA)). 1974. Contract AT(11-1)-2319. 11p. Dep. NTIS $4.00.

During this report period the RECE-Berta measurements in which a vertical field gradient of up to about 1% was added to the existing mirror field and the respective detailed analyses were completed. The measurements and the analysis of the changes in the average energy of the fast electrons were also completed. Some results of the vertical field gradient are described. A theoretical model for the stabilization of the precessional mode is briefly discussed. A systems analysis for fusion reactors based on plasma confinement in high-energy ion rings was completed. A brief discussion of the analysis is given. (MOW)

3164 (IAE-2285) POSSIBILITY OF CREATING A TOKAMAK REACTOR OPERATING ON DEUTERIUM. Popkov, G. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 12p. (In Russian). INIS.

The following parameters were determined: concentration, temperature, and the degree of burnout of the working substance in which the nuclear energy evolution in the charged particles exceeds the bremsstrahlung radiation. These calculations were carried out with the accompanying D-T and ^{3}He-D reactions being taken into account. It was assumed that the charged reaction products give up all their energy to the plasma. The possibility of building a tokamak reactor is considered on the assumption of various functional dependencies of the energy life-time of the plasma as a function of reactor parameters with cyclotron radiation being taken into account. It is shown that various assumptions on thermal insulation of the plasma have no substantial effect on the results. However, to obtain a positive energy balance it is necessary to decrease considerably the cyclotron radiation. It is possible to do this either by creating ideally reflecting chamber walls, or by increasing β_1 (β_ϕ > 1) and lowering q (q < 1) or finally, by considerably increasing the dimensions of the system. In order to start up the reactor it is necessary to have a plasma heating system operating at high efficiency. The tokamak reactor operating on deuterium can be built if the following theoretical difficulties can be overcome: (1) creation of a plasma containing no impurities, and (2) attainment of β_ϕ > 1 and q < 1. (SJR)

3165 (IPP-2/224) STELLARATOR WENDELSTEIN W VII. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). June 1974. 116p. (CONF-740630-5). Dep. NTIS (US Sales Only) $9.00.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

This report covers the material presented by the Garching Wendelstein W VII group at the 8th Symposium on Fusion Technology, Nordwijkerhout, The Netherlands, June 17 to 21, 1974. The following papers were presented: (1) technical concept and status of the W VII Stellarator, (2) the effect of perturbations on the magnetic field of the W VII Stellarator, (3) torus with Helix W VII A, and (4) high-power dc neutral particle injection for W VII. (auth)

3166 (KFK-2016) DEVELOPMENT AND CONSTRUCTION OF AN INJECTOR USING HYDROGEN CLUSTER IONS FOR NUCLEAR FUSION DEVICES. Status Report as of December 1973. Becker, E. W.; Falter, H.; Hagena, O. F.; Henkes, W.; Klingelhoefer, R.; Koerting, K.; Mikosch, F.; Moser, H.; Obert, W.; Wuest, J. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Kernverfahrenstechnik). Jul 1974. 32p. Dep. NTIS (US Sales Only) $4.50.

To provide a relevant amount of beam power for heating the W VII-plasma the design data for the cluster-injector are: 10 A equivalent beam current of neutral hydrogen atoms, 1 MV accelerating voltage, and 10^2 hydrogen atoms per cluster mean size of the singly ionized clusters corresponding to a beam power of 100 kW. The high voltage generator is almost completed and available for preliminary experiments on the high gradient acceleration of cluster ions at the Institute of Nuclear Physics of the University of Lyon. The injector structure and the cryostat for the cluster beam source will be manufactured by industry during the next two years. In the meantime the ionizer of the 10 A equivalent cluster beam will be developed by IKVT and experiments dealing with the neutralization of 1 MeV cluster ion beams will be carried through with the low current 1 MV accelerator of the Institut für Aerobiologie (IFA) of the Fraunhofer Gesellschaft in Grafschaft, Germany. (auth)

3167 (LA-tr-74-34) RESEARCH REPORT, 1972. Wienecke, R. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Plasmaforschung). 1972. Translation of pp 34-60 from IPF-LA-1. 30p. Dep. NTIS $4.50.

Research summaries are given for the following topics: (1) snowplow calculations of plasma focussing, (2) MHD calculations for the minifocus and Nessi focusing apparatuses, (3) particle-in-cell calculations for the plasma focus, (4) run-away effect and doublestream instabilities in plasma focusing, (5) stream distribution measurements on the minifocus, (6) optical diagnostics of plasma focusing, (7) calculations for the interaction of shock waves with electric fields, and (8) interaction of shock-produced plasma with magnetic fields. (MOW)

3168 (ORNL-TM-4696) COMPARISON OF THE CROSS-SECTION SENSITIVITY OF THE TRITIUM BREEDING RATIO IN VARIOUS FUSION-REACTOR BLANKETS. Alsmiller, R. G. Jr.; Santoro, R. T.; Barish, J.; Gabriel, T. A. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 35p. Dep. NTIS $4.75.

For several proposed fusion-reactor-blanket designs, the sensitivities of the tritium breeding ratios to uncertainties in nuclear cross-section data are presented and compared. The designs considered are those proposed at the Oak Ridge National Laboratory, the reference theta-pinch reactor design proposed at the Los Alamos Scientific Laboratory, and the reference fusion power plant design proposed at the Princeton Plasma Physics Laboratory. Results are presented for the changes in the breeding ratios due to estimated energy-dependent uncertainties in various partial cross sections of ^{6}Li, ^{7}Li, C, Be, and F. The ^{7}Li(n,n')α,t cross section, the Be(n,2n') cross section, and the F total cross section are found to introduce uncertainties of the order of a few percent in the breeding ratios for the various designs. Sensitivity profiles which show the changes in the breeding ratios due to changes in these cross sections in specific energy ranges are presented. (auth)

3169 (ORNL-TM-4707) PLASMA PHYSICS CONSIDERATIONS FOR A TOKAMAK FUSION TEST REACTOR: ORMAK F/BX. Hogan, J. T. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 106p. Dep. NTIS $8.50.

Some plasma physics aspects of the F/BX study which culminated in a proposal to construct a Tokamak Fusion Test Reactor (TFTR) are summarized. The most important goals of the TFTR were seen to be these: (1) it must contain a D-T plasma sufficiently well to return an amount of thermonuclear energy equal to the energy required to sustain the plasma; (2) it must produce a "reactor-grade" plasma, which simulates most physical processes to occur in the next evolutionary step: the Experimental Power Reactor (EPR); and (3) it must represent a reasonable scaling step in size from the next generation of hydrogen experiments (PLT and T-10). (auth)

3170 (ORNL-TM-4708) FEASIBILITY STUDY OF A HONEYCOMB VACUUM WALL FOR FUSION REACTORS. Cramer, S. N.; Oblow, E. M. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 32p. Dep. NTIS $4.75.

Honeycombing the vacuum wall of plasma devices has been proposed at ORNL to reduce the sputtering and refluxing of neutral impurities into the plasma. A preliminary evaluation of the feasibility of such a honeycomb wall concept was performed using a series of Monte Carlo simulations of sputtering interactions in a cylindrical honeycomb cell. These calculations parameterized the length-to-diameter ratio (L/D) of the cell and the sputtering yield data (because of the unavailability of the data in some important areas) to determine: (1) the sensitivity of the design to sputtering data, (2) the optimum L/D of the cell, and (3) whether a significant reduction in sputtering yield results from honeycombing the wall. The preliminary results obtained so far are encouraging in that small L/D ratios (close to unity) appear to be optimum and a factor of three to four reduction in sputtering yields appears feasible. In addition, these results do not appear to be unduly sensitive to the sputtering data within reasonable uncertainty bounds. (auth)

3171 (SAND-74-8605) PROTON-INDUCED ELECTRON EMISSION FROM CHARACTERIZED NIOBIUM SURFACES. Musket, R. G. (Sandia Labs., Livermore, Calif. (USA)). Sep 1974. Contract AT(29-1)-789. 23p. (CONF-741015-6). Dep. NTIS $4.25.

From 21st national symposium of the American Vacuum Society; Anaheim, California, USA (19 Oct 1974).

Both the electron emission coefficient (electrons/ion) and the energy distribution of emitted electrons have been determined for bombardment of polycrystalline niobium by 30 to 400 keV protons. In situ characterization of the niobium surfaces was accomplished using electron-induced Auger electron spectroscopy. Emission coefficient measurements were made for protons incident along the surface normal and along the axis at 45 from the surface normal. Electron energy distributions were determined using a hemispherical retarding analyzer with the proton beam at 45 from the surface normal and at 90 from and coplanar with the axis of the analyzer. The results are discussed and interpreted with reference to electron emission theories and previous experiments. (auth)

3172 (SLA-74-5332) COMPUTER SIMULATION OF FOCUSED ION BEAMS. Boers, J. E.; Freeman, J. R.; Poukey, J. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 9p. (CONF-741019-1). Dep. NTIS $4.00.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

Two digital computer programs were employed in the simulation of plasma expansion cups and the ion beams drawn from them. The axially symmetric ion beam is simulated with a relativistic beam program assuming that a particular plasma surface exists on the plasma expansion cup. Electrodes are employed which produce a focused ion beam at the voltage and current desired assuming space-charge-limited emission from the plasma surface. Then, boundary conditions are taken from the beam simulation near the plasma surface and used as input data for the plasma simulation program. The shape of the cup and the plasma injection rate can then be varied until the proper ion current is obtained from a surface close to that assumed in the beam program. Using this technique, deuteron beams of more than one ampere of current and source current densities in excess of 10^4 A/m^2 were simulated. (auth)

3173 (SLL-74-0223) SUPERCONDUCTING SWITCHES USING RADIATION INDUCED QUENCHING. Schmieder, R. W. (Sandia Labs., Livermore, Calif. (USA)). Oct 1974. Contract AT(29-1)-789. 8p. Dep. NTIS $4.00.

The use of penetrating radiation such as x-rays or high energy electrons to cause quenching of a superconducting short across an inductive energy store, thereby switching the persistent current into an external load, is examined. The basic equations describing this process within the two-fluid model are presented, and estimates of the size of megampere switches are made. The ratio of switching energy to switched energy is derived, and x-ray vs. electron impact quenching is discussed. Several geometries for practical switches are presented. (auth)

3174 (UCID-16625) DT FUSION NEUTRON IRRADIATION OF BPNL MOLYBDENUM AND ORNL MAGNESIUM OXIDE CRYSTAL. MacLean, S. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Oct 1974. Contract W-7405-eng-48. 3p. Dep. NTIS $4.00.

The samples were stacked with niobium dosimetry foils and taped on the front of a lucite holder. Neutron production was monitored continuously with a proton recoil counter and recorded each hour. Total beam-on time was 8.03 hours. The average fluence on each dosimetry foil is given. No results are given. (MOW)

3175 (UCRL-51630) NONDESTRUCTIVE TESTING OF LASER TARGETS. Reedy, R. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jul 1974. Contract W-7405-eng-48. 29p. Dep. NTIS $4.00.

Very small, hollow spheres—referred to as microballoons—are commercially manufactured for various uses. They are made of several types of glass and plastics and range in size from a few to several hundred microns in diameter. Inspecting and selecting microballoons suitable for laser targets is the subject of this report. Several testing techniques are described that make use of the optical properties of these hollow spheres. These tests can determine: (1) the spheroidicity of the outer surface, (2) the concentricity of the inside and outside wall surfaces, (3) the wall thickness, and (4) defects in the walls. (auth)

3176 (UCRL-51650) POWER EFFICIENCIES OF NEUTRAL BEAM SYSTEMS. Fink, J. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Sep 1974. Contract W-7405-eng-48. 17p. Dep. NTIS $4.00.

The power efficiencies of several neutral beam systems are presented as functions of beam energy. Direct injection systems are found to be most efficient at low beam energies while negative ion systems are best at high energies. In the intermediate range, post acceleration is best. (auth)

3177 (UCRL-75543) HIGH DENSITY FUSION AND THE Z-PINCH. Hartman, C. W.; Cheng, D. Y.; Cooper, G. E.; Eddleman, J. L.; Munger, R. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Sep 1974. 14p. (CONF-741105-29). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

The formation of a z-pinch in dense gas was investigated using numerical modeling in 1- and 2-dimensions. Hot, dense z-pinches were calculated with $n \approx 2 \times 10^{21}$ cm^3 and T = 10 keV. Relaxation by sausage instability of an unstable pinch profile to a marginally stable one was calculated along with end losses in 2-dimensions to show that if plasma is confined for N = 50 to 200 sound transits across the radius a, pinches with length L = Na are of interest for fusion power. A conceptual, "no-wall" fusion reactor is discussed. (auth)

3178 (UCRL-75826) MODULARIZED MIRROR FUSION REACTOR CONCEPT WITH EMPHASIS ON FABRICABILITY, ASSEMBLY, AND DISASSEMBLY. Peterson, M. A.; Werner, R. W.; Hoffman, M. A.; Carlson, G. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Oct 1974. 55p. (CONF-741017-23). Dep. NTIS $5.75.

From meeting of the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

A progress report on a continuing study directed toward the development of mirror reactor designs which simultaneously satisfy the various engineering, economic, and maintenance considerations is presented. Two new blanket and coil structure designs are presented which satisfy engineering requirements equally as well as previous designs while offering substantial gains in economic viability and accessibility for maintenance. Because of the commercial requirement for a high duty cycle and the possible high frequency of blanket module removal—for either maintenance or replacement—the module removal must be accomplished quickly with a minimum disruption of reactor operations. The blanket and coil structure designs presented allow the removal of any one of the identical blanket modules without disturbing either the remaining modules or the coil and its associated support structure. In addition to offering improved blanket accessibility, the new coil structural support designs greatly reduce (from 5 to 10 times) the required volume of structural material relative to the previous "shell and filler" design. With fabricated coil structure costs estimated at $2.50/lbm and the reactor net electrical power calculated from a plasma and reactor system model detailed in the paper, coil and support structure costs of under $50/Kwe were estimated. The reduction in the cost of the coil and its associated support structure from the previous design results in a substantial reduction in the cost of the entire reactor system, because the previous magnet containment structure constituted a sizable fraction of the total reactor system cost. (auth)

3179 (UCRL-75828) FUSION REACTOR FIRST-WALL COOLING FOR VERY HIGH ENERGY FLUXES. Hoffman, M. A.; Werner, R. W.; Roose, T. R.; Carlson, G. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Oct 1974. 44p. (CONF-741017-22). Dep. NTIS $5.25.

From meeting of the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

A study was made of the feasibility of a protective first wall shield between the plasma and the containment vessel for early experimental controlled thermonuclear fusion machines. The proposed first-wall shield is a water-cooled array of thin-walled tubes designed to take very high local energy fluxes originating from the neutral beam injectors. Detailed computer calculations reveal that heat flux capabilities of 3300 W/cm^2 are possible with first-wall shield sections made up of tubes 1 meter long of Ta-10W alloy (with tube inner diameters of 10 mm and tube wall thickness of 0.5 mm) with a structural safety factor of about 4. If the structural safety factor can be lowered to 3, the heat flux capability can be increased to 4200 W/cm^2. Required pumping powers on the order of 1 MW per square meter of first wall area exposed to these high energy fluxes are predicted for flow in the non-boiling regime. If operation in the subcooled nucleate boiling regime can be achieved without flow oscillations or instabilities, the required pumping power is shown to decrease by about an order of magnitude (because the same heat flux capability can be achieved at lower flow rate). (auth)

3180 (UCRL-76055) CONCEPTUAL DESIGN OF A MIRROR REACTOR FOR A FUSION ENGINEERING RESEARCH FACILITY (FERF). Batzer, T. H.; Hamilton, G. W.; Hooper, E. B. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Sep 1974. 16p. (CONF-741105-30). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion reaction; Tokyo, Japan (11 Nov 1974).

A conceptual design is presented for a small mirror fusion reactor for a Fusion Engineering Research Facility (FERF). The reactor produces 3.4 MW of fusion power and a useful neutron flux of about 10^{14} $n/cm^2/s$. Superconducting "yin-yang" coils are used, and the plasma is sustained by injection of energetic neutral D^0 and T^0. Conceptual layouts are given for the reactor, its major components, and supporting facilities. (auth)

3181 TOKAMAK DEVICES. Itoh, S.; Takeda, T. (Japan Atomic Energy Research Inst., Tokai). Oyo Butsuri; 43: No. 3, 246-254(Mar 1974). (In Japanese).

Technological and engineering problems of a tokamak device are surveyed. The history of a tokamak device is presented and the importance of attaining a good vacuum condition and problems concerning the production of high magnetic fields are pointed out. Some problems on future large tokamaks are also pointed out. (auth)

3182 MINIMIZATION OF DISPLACEMENT OF PLASMA COLUMN IN A TOROIDAL MAGNETIC FIELD WITH A NON-PLANAR AXIS. Kondoh, Y. (Gunma Univ., Kiryu, Japan); Nagao, S.; Sugita, K.; Watanabe, H. J. Phys. Soc. Jap.; 36: No. 4, 852-856(Mar 1974).

The system with a toroidal helical magnetic axis is re-examined numerically to obtain the minimum displacement of the plasma column in an infinitely conducting chamber wall. The results of the numerical calculation show that in order to minimize the displacement of the plasma column in the toroidal helical system, one should have a device with a large number of pitch n, for example $n = 32$, and in such a device the β value of the equilibrium state is permitted up to 100 percent. A rule which determines the optimum condition for the minimization of the displacement is shown by the figure. (auth)

3183 USE OF THE PARTITIVE ANALYTICAL FORECASTING (PAF) TECHNIQUE FOR ANALYSIS OF THE EFFECTS OF VARIOUS FUNDING AND ADMINISTRATIVE STRATEGIES OF NUCLEAR FUSION POWER PLANT DEVELOPMENT. Vanston, J. H. Jr. Austin, TX; Univ. of Texas (1974). 490p. University Microfilms Order No. 74-14,779.

Thesis (Ph. D.).

The use of a new technique, Partitive Analytical Forecasting (PAF), is proposed for the analysis of the effects of various funding strategies on complex, long-term development programs involving large uncertainties in timing and probability of eventual success. PAF procedures are explained and their use is illustrated by application to a major portion of the nuclear fusion power development program. A brief description of the present state of development of the fusion power program is presented together with a discussion of the structure and capabilities of the computer program used in the investigation, the GRAPHICAL EVALUATION AND REVIEW TECHNIQUE (GERTS) IIIZ program. The logic network used for simulation of the fusion development program is presented, along with the rationale supporting its structure. Two approaches to a fusion reactor are considered, both involving heated plasma magnetically contained in closed toroidal field, but differing in the plasma heating methods employed. The model considers scientific, engineering, and administrative factors and accounts for time required for research, design, construction, evaluation, and administrative decision. The technique used for gathering and correlating input data is presented and evaluated, and the input data itself is listed. (Diss. Abstr. Int., B)

3184 NEUTRONIC AND PHOTONIC ANALYSES OF SIMULATED FUSION REACTOR BLANKETS CONTAINING THORIUM AND NATURAL URANIUM. Parish, T. A. Austin, TX; Univ. of Texas (1974). 348p. University Microfilms Order No. 74-14,746.

Thesis (Ph. D.).

The neutronic and photonic characteristics of fusion reactor blankets containing thorium and natural uranium fission fuel were investigated. The basic neutron cross section data used in the analyses were taken from the ENDF/B Version III library. Neutron multi-group constants were generated with SUPERTOG. Neutron kerma factors for all materials except thorium and uranium were calculated with AVKER. POPOP4 and POPLIB were used to generate the secondary gamma ray production cross sections. Photon cross sections were computed with MUG. Computer programs were written to compute cross sections for the (n,3n) reactions, neutron kerma factors, and resonance self-shielding effects. The ANISN program was used for the neutron and gamma ray transport calculations. The standard blanket model was calculated to verify the methods. The thorium and natural uranium fuel was added to the standard blanket which was liquid lithium cooled and possessed a niobium vacuum wall. The thickness of the region containing thorium or uranium was varied. Reaction rates such as (n,γ), $(n,2n)$, etc., were calculated for the first and second niobium walls of the blankets. In addition, the tritium breeding, fission power, and heat deposition by blanket region were computed and presented for the fusion-fission blankets. The energy leakages from these blankets were also calculated and compared to the results for the standard blanket. (Diss. Abstr. Int., B)

3185 ION SOURCE. Reifenschweiler, O. (to U. S. Philips Corp.). US Patent 3,833,829. 3 Sep 1974. Priority date 3 Jan 1972, Netherlands. 4p.

An ion source having an anode between two cathodes and means for producing an axial magnetic field is described. Detremental heating of the cathode present opposite to the ion exit aperture by particles which are accelerated in the reverse direction and have a charge which is opposite to that of the extracted ion beam is prevented. For that purpose the cathode and the means for producing an axial magnetic field have an axial aperture. A collector electrode is present for capturing the relevant particles. The ion source is particularly suitable for a sealed neutron generator. (Official Gazette)

3186 IRRADIATION SWELLING, CREEP, THERMAL SHOCK AND THERMAL CYCLING FATIQUE ANALYSIS OF CYLINDRICAL CONTROLLED THERMONUCLEAR REACTOR FIRST WALL. Ma, B. M. (Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Nuclear Engineering). Nucl. Eng. Des.; 28: No. 1, 1-30 (1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1974).

The irradiation swelling, irradiation creep, and thermal shock and thermal cycling fatigue developed in the first wall of the cylindrical controlled thermonuclear reactor (CTR) are analyzed theoretically on the basis of experimental results. The first wall will suffer heavy radiation damage from fast neutrons, primary γ (or X-) rays, and high energy charged particles produced in the thermonuclear reactions. The void formation, void density, mean void diameter, and volume change due to nuclear irradiation in the first wall will increase or vary with the neutron fluence, irradiation temperature, helium production, and atom displacement damage of the wall material. Irradiation swelling can greatly enhance the irradiation creep rate. The relationships between the irradiation creep strain, neutron fluence, and radiation-induced creep stress are introduced on the basis of experimental data. Computed results of the principal stresses and strain rates obtained from the radiation, thermal, and creep analysis are depicted by graphs. Correlation equations for thermal shock and thermal cycling fatigue are derived on the basis of analytical and experimental results. From experimental data analysis the effects of hold time and crack initiation, propagation, and growth on cyclic fatigue life of the first wall can be predicted. It is postulated that the shearing stress can nucleate cracks and that the maximum principal stress can propagate and extend cracks along the failure plane normal to the principal stress. The damage resistance criterion for irradiation swelling, irradiation creep, and thermal shock and thermal cycling fatigue is proposed. The theoretical analysis and experimental results can be correlated, compared and verified in the development of a CTR first wall when equivalent uniaxial tests (instead of multiaxial complicated experiments) of the first wall material are conducted. (auth)

3187 APPLICATIONS OF FUSION POWER TECHNOLOGY. Beller, M.; Powell, J. R.; Steinberg, M. (Brookhaven National Lab., Upton, NY). Chem. Eng. Progr.; 70: No. 11, 82-88(Nov 1974).

This overview pointed up a large number of energy intensive, high volume chemicals to which various energy forms from CTR may be applied. The present energy situation indicates that even if fossil fuel supplies are available, the rising cost of these fuels will lead to closer comparisons with alternative non-fossil energy forms. Obviously, electric power from CTR will be utilized in those processes which are dependent on this energy form, but it may also be used in other processes which previously used other energy sources. This can be done either directly, or indirectly via hydrogen or liquid fuels derived from CTR power. (auth)

3188 RELAXATION OF TOROIDAL PLASMA AND GENERATION OF REVERSE MAGNETIC FIELDS. Taylor, J.B. (Culham Laboratory, Abingdon, Berkshire, England). Phys. Rev. Lett. 33: No. 19, 1139-1141 (4 Nov 1974).

The spontaneous generation of reversed fields in toroidal plasmas is shown to be a consequence of relaxation under constraints. With perfect conductivity a topological constraint exists for each field line and the final state is not unique. With small departures from perfect conductivity, topological constraints are relaxed and the final state becomes unique. The onset of the reversed field and other features of this model agree well with observations on ZETA. (auth)

3189 BURN CHARACTERISTICS OF MARGINAL DEUTERIUM–TRITIUM MICROSPHERES. Henderson, D.B. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Phys. Rev. Lett. 33: No. 19, 1142-1144 (4 Nov 1974).

Long mean free paths for ions in the tail of the distribution may allow escape, quenching the burn of marginal ($\rho R < 10^{-2}$ g/cm^2) deuterium–tritium microspheres, possibly explaining the lack of success in experiments to date. (auth)

3190 MIGMA FUSION REACTOR. (To International Fusion Energy Corp.). Netherlands Patent A7,305,794. 25 Apr 1973. Priority Date 25 Apr 1972, USA. 38p. (In Dutch).

A nonplasma, nonthermal fusion reactor for controlled release of nuclear fusion power by interacting self-colliding accelerated ions of like charge in an organized mixture of ion orbits (called a "migma"), as well as the direct conversion into electricity of the energy of the fusion products is disclosed. A magnetic field is produced within an evacuated volume, whose strength decreases with the radial distance from the central axis and increases with the distance along the central axis from the center plane, and a beam of positively charged ions is injected from the periphery into the center of symmetry of said magnetic field with induced vertical oscillation and with a fast initial rate of injection. The magnetic field induces precession of and exerts radial and axial focusing forces on the ions in orbit within the volume producing confinement and self-colliding of the ions causing fusion reactions in the resultant mixture of the precessing positively charged ion orbits at all crossing angles and over entire orbits with the reaction rate enhanced in the central zone. The density of the injected ions is maintained at a level such that charged nuclei resulting from the fusion reactions are caused to be emitted from the reaction volume into a region of high repulsive electrical potential whereby the deceleration energy of the nuclei is directly extracted as electrical energy. It also is possible, using selected values of the injection energy to achieve a fuel breeding effect thus increasing the power output. (NL)

Wave Phenomena

Refer also to abstracts 3123, 4267, 4460, 4490, and 5080.

3191 (AD-778572) REFLECTION AND REFRACTION OF ELECTROMAGNETIC WAVES BY A MOVING IONIZATION REGION. Sorokin, Yu. M.; Stepanov, N. S. Translated by R. E. Zarza from Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 14: No. 5, 686-689(1971). 10p. NTIS $3.00.

The interaction of electromagnetic waves with a uniformly, moving ionization region in immovable medium is considered. It is shown that the reflection and refraction coefficients may be expressed through the corresponding coefficients for the immovable plasma layer of the analogous profile. The relations obtained contain total energies and frequencies of the interacting waves at different velocities of the ionization wave. Unlike the moving inhomogeneous plasma, the total signal energy and the quantum number decrease in all cases. (auth)

3192 (AEC-tr-7585) TWO EXAMPLES OF THE COLLAPSE OF LANGMUIRIAN WAVES. Degtyarev, L. M.; Zakharov, V. E.; Rudakov, L. I. (AN SSSR, Moscow. Inst. Prikladnoj Matematiki). Oct 1974. Translation by W. J. Grimes of Preprint No. 35. 18p. Dep. NTIS $4.00.

Two examples of the collapse of Langmuirian waves are presented—a highly nonlinear process of concentration of oscillations in regions of reduced plasma density. The first example considers on a numerical and analytical basis the collapse of a unidimensional spherical soliton toward the center, while the second considers the nonlinear stage of instability in the two-dimensional case of a plane soliton. (auth)

3193 (COO-2288-7) ABSORPTION OF ELECTROMAGNETIC WAVES NEAR THE CRITICAL DENSITY. Quarterly Progress Report, June 1, 1974–September 1, 1974. Rehm, R. G.; Daiber, J. W.; Thompson, H. M. (Calspan Corp., Buffalo, N. Y. (USA)). 1974. Contract AT(11-1)-2288. 3p. Dep. NTIS $4.00.

An experimental study of the interaction of high-intensity ruby laser radiation with hydrogen gas in a free-jet is described. In these experiments both laser intensity and the plasma frequency can be varied. By monitoring several parameters, including incident and reflected power, x-ray emission and the kinematics of plasma growth, the existence of an anomalous threshold for coupling radiation into plasma energy should be determinable. (auth)

3194 (IPP-1/147) ION SOUND SPECTRUM AND ELECTRON-WAVE INTERACTION IN PERPENDICULAR SHOCKS. Biskamp, D.; Chodura, R.; Dum, C. T. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Jul 1974. 14p. (IPP-6/126). Dep. NTIS (US Sales Only) $4.00.

A theory is presented for the rotation of the ion acoustic spectrum with respect to the drift velocity as observed in perpendicular shocks. The results of 2D simulation confirm the main points of the theory and represent a direct verification of perturbed orbit theory of strong turbulence. (auth)

3195 (UCSD-34-P-85-19) THEORETICAL PLASMA PHYSICS RESEARCH. Progress Report, November 1, 1973–October 31, 1974. Thompson, W. B. (California Univ., La Jolla, San Diego (USA)). 1974. Contract AT(04-3)-34. 45p. Dep. NTIS $5.25.

An examination of the fluctuation spectra in a magnetized plasma has shown that radiation scatter can be used to map the magnetic field inside a plasma. A radiative transport equation was developed, and its properties explored. It was shown that propagating ion acoustic modes can enhance the scattering form factor by a factor of 60 at low frequencies. Several new expansions of the dielectric function for a magnetized plasma were given, which display the limiting behavior and permit a reasonably simple analysis of drift waves. The role of propagating waves in diffusion was explored, and an example of pseudoclassical diffusion exhibited. A new method of exploring plasma waves was developed using the distortion in the distribution function rather than the dispersion relation. An analysis of the role of MHD singularities in the propagation of slow waves through a plasma slab has shown anomalous power absorption. For instance, a Tokamak at 500 eV shows an effective resistance of .02 ohms to a properly selected wave in an external structure, and this increases as $T^{1/2}$. An analysis of this problem, using the guiding center equations, has shown that for a hot electron plasma similar results hold. The velocity distribution function for a slowing down ion beam was derived and the associated velocity space instabilities explored. Stability against ion acoustic modes demands careful beam design. (auth)

3196 PHYSICAL PICTURE FOR THE ANOMALOUS PROPAGATION OF AN ORDINARY WAVE IN A MAGNETOPLASMA. Ishida, A. (Hiroshima Univ.); Kitao, K. J. Phys. Soc. Jap.; 36: No. 3, 919(Mar 1974).

3197 SUPERSONIC–SUBSONIC FLOW TRANSITION AND SHOCK FORMATION OF A PLASMA BEAM IN AN ASYMMETRIC MIRROR MACHINE. Toffolo, W. E. Pittsburgh; Carnegie-Mellon Univ. (1974). 168p. University Microfilms Order No. 74-17,322.

Thesis (Ph. D.).

The axial injection of a supersonic high density plasma beam into an asymmetric mirror machine is investigated experimentally. It is found that, in front of the second mirror peak, two supersonic-subsonic flow transitions and shock formations occur, leading to reflection, thermalization and trapping of part of the plasma beam. The reflected portion of the plasma beam is moving upstream with one-third the speed of sound, in the neighborhood of shock formation and reflection. In a second experiment, the region between the two mirrors is enclosed radially by a helical slow-wave structure excited at 2.5 GHz and 1 kW. It is found that the shock formation and reflection at the supersonic-subsonic flow transition is enhanced by the microwaves so applied. The plasma transmission through the second, exit, mirror is reduced; the electron temperature is enhanced throughout; and at lower values of applied magnetic field a shock is formed due in its entirety to the application of the microwaves, at a microwave frequency near the electron cyclotron frequency. The helium plasma beam is produced by a conical theta-pinch gun driven by a capacitor bank with a stored energy of 3 kJ. Measurements are made of the plasma density, temperature and streaming velocity. (Diss. Abstr. Int., B)

3198 PLASMA HEATING AND GRADIENT MODIFICATIONS BY RESONANT ABSORPTION. Estabrook, K. G.; Valeo, E.; Kruer, W. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Phys. Lett., A; 49: No. 2, 109-110(26 Aug 1974).

Results of two-dimensional electromagnetic simulations of linear mode conversion in an inhomogeneous, freely expanding plasma are reported. Important modifications of the plasma profile are shown to be intrinsic to the process. (auth)

3199 MEASUREMENT OF PLASMA WAVE SPECTRAL DENSITY FROM THE CROSS–POWER DENSITY SPECTRUM. Harker, K.J.; Ilić, D.B. (Institute for Plasma Research, Stanford University, Stanford, California 94305). Rev. Sci. Instrum. 45: No. 11, 1315-1324 (Nov 1974).

Determination of the spectral density of plasma waves from the cross–power density spectrum is shown to be simpler than the alternative determination from the cross–correlation function. A device for measuring the cross–power spectral density is described in detail. A model with a bandwidth of 30 MHz has been constructed using integrated circuits, and applied to the study of ion acoustic wave propagation on a plasma positive column. Since it is an analog device, it should be possible to extend the bandwidth for operation into the gigahertz range. Only a fixed delay is required to measure the quadrature component of the cross–power spectral density. These features are in contrast to other correlators and cross–power spectrum analyzers described to date, which are either limited to the low megahertz range, or require a variable delay line. (auth)

3200 RESONANT TRANSFORMATION OF WAVE POLARIZATION DUE TO PLASMA NONUNIFORMITY. Faulconer, D.W.; Messiaen, A.M.; Vandenplas, P.E. (Plasma Physics Laboratory, Association "Euratom–Belgian State," Ecole Royale Militaire—Koninklijke Militaire School, 1040 Brussels, Belgium). Phys. Fluids 17: No. 8, 1566-1573 (Aug 1974).

When a transverse electric wave is incident on a plama column with an axial density gradient, the resultant scattered field is not purely transverse electric, but also has a transverse magnetic component. The relative importance of the latter is strongly enhanced at the main resonance of the plasma cylinder, its absolute magnitude becoming great even for moderate values of the axial density gradient. The present study is limited to a perturbation analysis of the effect. The inclusion of this effect leads to a much closer agreement between theory and experiment in the positive column of a discharge than was the case for a previous theory which only accounted for transverse electric to transverse magnetic transformation due to plasma axial drift along the column. (auth)

3201 PROPAGATION AND MODE CONVERSION OF LOWER–HYBRID WAVES GENERATED BY A FINITE SOURCE. Bellan, P.M.; Porkolab, M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 17: No. 8, 1592-1601 (Aug 1974).

The propagation of electrostatic plasma waves, and their subsequent conversion into hot plasma waves at the lower hybrid frequency is calculated for realistic density profiles and finite rf sources in a slab geometry. A finite length slow wave source having a potential distribution $\phi \sim \cos k_0 z$ is found to generate spatial oscillations having a well–defined wavelength. These oscillations are confined to regions bounded by conical curves originating at the ends of the source. The axial distance of rf energy propagation to the lower hybrid layer is found to be greater than the radial distance of propagation by a factor of the order $(m_i/m_e)^{1/2}$. The conversion at the lower hybrid layer of the electrostatic cold plasma waves excited by a finite source into propagating hot plasma waves is calculated. It is shown that collisional damping at the lower hybrid layer may predominate over mode conversion even for relatively low collision frequencies. (auth)

3202 CYLINDRICAL SOLITONS. Maxon, S.; Viecelli, J. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Fluids 17: No. 8, 1614-1616 (Aug 1974).

The modified Korteweg–de Vries equation appropriate to small amplitude, cylindrically symmetric ion acoustic waves is given. The numerical solution is obtained and compared with recent work on spherical solitons. (auth)

3203 KRYLOV–BOGOLIUBOV–MITROPOLSKY METHOD FOR NONLINEAR WAVE MODULATION. Kakutani, T.; Sugimoto, N. (Faculty of Engineering Science, Osaka University, Toyonaka, Osaka, Japan). Phys. Fluids 17: No. 8, 1617-1625 (Aug 1974).

The Krylov–Bogoliubov–Mitropolsky perturbation method is applied to systems of nonlinear dispersive waves including plasma waves such as ion–acoustic, magneto–acoustic, and electron plasma waves. It is found that long time slow modulation of the complex wave amplitude can be described by the nonlinear Schrödinger equation for a very wide class of nonlinear dispersive waves. (auth)

3204 RESONANCE CONES FOR FREQUENCIES BELOW THE ION CYCLOTRON FREQUENCY. Kuehl, H.H. (University of Southern California, Los Angeles, California 90007). Phys. Fluids 17: No. 8, 1636-1637 (Aug 1974).

For frequencies below the ion cyclotron frequency, it is shown that, the potential of an oscillating point charge in a magnetized plasma contains a new resonance cone which is due to the electrostatic ion wave. (auth)

3205 PROPAGATION ALONG A DIELECTRIC–COATED CYLINDER IMMERSED IN PLASMA. Basu, J.; Maiti, J.N. (Saha Institute of Nuclear Physics, Calcutta, India). J. Appl. Phys. 45: No. 11, 4795-4796 (Nov 1974).

The dispersion relation for propagation in the TM_{01} mode along a dielectric–coated perfectly conducting cylinder immersed in plasma is studied. The dispersion characteristics reveal some interesting and novel features for negative values of the dielectric constant of the plasma. (auth)

3206 MEASUREMENT OF SUBSONIC LASER ABSORPTION WAVE PROPAGATION CHARACTERISTICS AT 10.6 μm. Klosterman, E.L.; Byron, S.R. (Mathematical Sciences Northwest, Inc., Seattle, Washington 98105). J. Appl. Phys. 45: No. 11, 4751-4759 (Nov 1974).

An experimental study of subsonic laser absorption waves arising from the interaction of 10.6—μm radiation with metal and insulator target materials is described. A shock—tube—driven gas—dynamic laser operating up to 400 kW for 4 msec was used as the radiation source. Instrumentation included streak photography to determine wave speed, holographic interferometry to determine the gas density field, time—integrated visible spectroscopy to determine the principal radiating species, and CO_2 laser attenuation measurements to determine the plasma absorption coefficient. The results reported here emphasize the characteristics of waves in free and clean air, far from the influence of the target. The measured wave speeds in air at 1 atm pressure ranged from Mach 0.05 to 0.2 for CO_2 laser intensities ranging from 1×10^5 to 5×10^5 W/cm^2. The wave speeds were also found to depend on the laser beam diameter. The spectral emission and CO_2 laser absorption measurements showed that the air plasma reaches a temperature of 15000—20000 °K and is essentially fully ionized. From an analysis of the results, it is concluded that radiation transport in the plasma plays a dominant role as a wave propagation mechanism, and that radial flow ahead of and within the wave is a dominant feature of the wave structure. (auth)

3207 TRAVELING IONIZATION DISTURBANCE DURING MICROWAVE BREAKDOWN OF ARGON. McIntosh, R.E. (Department of Electrical and Computer Engineering, University of Massachusetts, Amherst, Massachusetts 01002). J. Appl. Phys. 45: No. 12, 5257-5259 (Dec 1974).

We report here the excitation of a propagating ionization disturbance during the transient microwave breakdown of argon. Evidence gathered from spectroscopic observations indicates that this disturbance travels away from the generating source at a velocity which depends on pressure and the magnitude of the microwave pulse. (auth)

3208 EVOLUTION OF PARAMETRICALLY EXCITED ION—ACOUSTIC WAVES. Klein, L.A.; Ru—Shao Cheo, B. (Polytechnic Institute of New York, Farmingdale, New York 11735); Stern, R.A. J. Appl. Phys. 45: No. 12, 5218-5224 (Dec 1974).

A technique for experimentally determining growth and decay characteristics of parametrically excited plasma waves is described. The method is based on switching the pump power between two levels and observing the evolution of the excited waves in time. By using a nonlinear phenomenological model, the linear damping frequency and decay rates of the excited waves are found as is a coupling coefficient between the pump and excited waves. Experiments were conducted in the positive column of an argon discharge in a Tonks—Dattner structure using a microwave pump. Observed damping of the excited ion—acoustic wave at pressures between 10 and 44 mTorr is shown to be consistent with ionization collisions, while the decay rate is shown to be a linear function of pump power. (auth)

ENGINEERING

Energy Conversion

3209 (AD-781261) OPERATING REPORT FOR RADIOISOTOPIC POWER GENERATORS OF THE U. S. NAVY. Volume 7, Number 2. Report for 1 April–31 December 1973. (Naval Nuclear Power Unit, Fort Belvoir, Va. (USA)). 31 Dec 1973. 85p. NTIS $4.00.

The objective of the report is to serve as a vehicle for the accumulation and dissemination of information concerning the application and operation of radioisotopic power generators (RPGS) within the navy. All RPGS presently listed are radioisotope thermoelectric generators (RTGS). Unless specifically identified as an engineering evaluation, items contained in this report are presented as an impartial collection of facts, observations and other information. The East Coast RPG Surveillance Facility (SURFAC) located at the Naval Nuclear Power Unit, Fort Belvoir, was placed operational on June 1, 1973. Three Sentinel 25-D's were placed operational on a tower operated by the Naval Coastal Systems Laboratory off the coast of Panama City, Florida. Three Sentinel 25-E's were recovered from the Amchitka Island, Alaska area and turned over to the U. S. Navy by the AEC. The AEC turned over the development SNAP-23A to the U. S. Navy. Eight Gulf one-watt RPG's were procured by the U. S. Navy. (auth)

3210 (GESP-7107(Pt. 1)) MULTI-HUNDRED WATT RADIOISOTOPE THERMOELECTRIC GENERATOR PROGRAM. Part I. Annual Report, 1 January 1973–31 December 1973. (General Electric Co., Philadelphia, Pa. (USA). Space Div.). 1973. Contract AT(29-2)-2831. 310p. (GEMS-418(Pt. 1)). Dep. NTIS $18.50.

Significant events, activities and achievements during 1973 in the MHW-RTG Program for developing RTG's for space missions are summarized. During the year full-scale qualification and flight hardware and ground support equipment were fabricated and tested. Preliminary tests in the safety program are reported. Radiological protection and safety analysis reports were issued. Performance requirements were developed from systems analyses and test data. In this volume, information is included on the safety analyses and tests; the RTG system; heat source design; fuel form; fuel capsule; fuel sphere assembly and associated hardware; gas management subsystem; and analysis and testing of the heat source assembly. (LCL)

3211 (GESP-7107(Pt. 2)) MULTI-HUNDRED WATT RADIOISOTOPE THERMOELECTRIC GENERATOR PROGRAM. Part II. Annual Report, 1 January 1973–31 December 1973. (General Electric Co., Philadelphia, Pa. (USA). Space Div.). 1973. Contract AT(29-2)-2831. 349p. (GEMS-418(Pt. 2)). Dep. NTIS $20.50.

Significant events, activities, and achievements during 1973 in the MHW-RTG program for developing RTG's for space missions are summarized. During the year full-scale qualification and flight hardware and ground support equipment were fabricated and tested. In this volume, information is included on converter design, development, and performance testing; product assurance; converter fabrication; acceptance and qualification testing; and ground support equipment such as the electric heat source, power supplies, and shipping and storage containers and handling equipment for the RTG. (LCL)

3212 (JPRS-63259) OPERATIONS WITH THE ''BETA-S'' AND ''PINGVIN'' THERMOELECTRIC ISOTOPE GENERATORS IN THE ANTARCTIC. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Translated from Inform. Byull. Sov. Antarkt. Eksped.; No. 88, 62-67(1974). 8p. NTIS.

Specifications and performance data are given for radioisotope-powered thermoelectric generators used to power automatic magnetic variation stations in the Antarctic. (TFD)

3213 (SLA-73-0912) DEVELOPMENT OF THE GLASS BONDING PROCESS FOR THE MC2730 THERMOPILE. Beauchamp, E. K.; Matsko, J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1974. Contract AT(29-1)-789. 50p. Dep. NTIS $5.50.

Techniques for bonding the 44 elements of the MC2730 thermopile into a rigid, strong assembly were developed. The requirement for a nearly pore-free bond to serve as a bridge for interelement contact metallizing has been met by using a thin layer of glass frit and vacuum hot pressing to virtually eliminate porosity. The bonding glass has been identified as a source for gases which produce porosity and procedures have been developed to prevent the release of the gases. Precise control over bond thickness has been obtained through improvements in screen printing and tape deposition processes and by elaborate fixturing during bonding. (auth)

3214 AN APPROXIMATE TECHNIQUE FOR ANALYZING THE PLASMA OF THERMIONIC CONVERTERS OPERATING IN THE IGNITED MODE. Ratafia, M.; Keck, J.C. (Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). J. Appl. Phys. 45: No. 11, 4806-4819 (Nov 1974).

An approximate analytic technique for solving the transport equations of thermionic energy converters is developed. Using an assumed parametric form for the ionization rate, the problem is reduced, essentially, to one of the solution of three simultaneous transcendental equations. A numerical iterative procedure for the solution of these equations is derived and implemented in a computer code and some illustrative solutions are obtained. A simple criterion for whether the converter is operating under equilibrium or nonequilibrium conditions and other simple relations describing the character of the solutions are derived. For nonequilibrium conditions, the assumed form for the ionization rate is found to agree well with the actual form, and the solutions obtained are in good agreement with previous results. The empirically observed minimum in the arc drop at the optimum value of the pressure–spacing product is predicted. The present theory is the only one known to the authors which shows this result. The solutions may be systematically improved by numerical integration and iteration and the range of applicability of the solutions can be extended to local thermodynamic equilibrium conditions by assuming a more general form for the electron production and to a greater variation in parameters by incorporating a recently derived improved set of boundary conditions into the analysis. (auth)

3215 EFFECT OF A SLIGHT TRACE OF CARBON DIOXIDE ON THE PROPERTIES OF HELIUM–CESIUM PLASMA. Karpukhin, V.T.; Leonov, P.G. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 12: No. 1, 165-166 (Sept 1974).

Results of some preliminary experiments on the effects of trace impurity (carbon dioxide) on the parameters of a helium-cesium discharge are presented. (AIP)

3216 EFFECT OF OXYGEN–ENRICHED AIR ON THE CHARACTERISTICS OF MHD POWER STATIONS WITH CHEMICAL REGENERATION. Popyrin, L.S.; Pshenichnov, N.N.; Rogachev, A.P.; Sokol'skii, A.G.; Shumyatskii, B.Y. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 12: No. 1, 170-171 (Sept 1974).

We report on the increased efficiency of MHD steam–turbine power stations when an oxygen–enriched environment is used instead of normal atmospheric air. (AIP)

3217 INVESTIGATION OF A NONISOTHERMAL MHD PLASMA WITH A TOTALLY IONIZED ADMIXTURE. Belykh, A.D.; Pashkin, S.V. (I. V. Kurchatov Institute of Atomic Energy). High Temp. 12: No. 1, 167-169 (Sept 1974).

We investigate the effect of total ionization of a $He+Cs^+$ plasma on the ionization instability of the plasma in a MHD generator. The probable causes of the resulting inhomogeneities are considered. (AIP)

Facilities and Equipment

Refer also to abstracts 3311, 3376, 5172, 5320, 5321, and 5334.

3218 (AE-498) DEPOSITION KINETICS OF CALCIUM HYDROXY APATITE ON HEAT TRANSFER SURFACES AT BOILING. Kelen, T.; Gustafsson, R. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Sep 1974. 30p. Dep. NTIS (US Sales Only) $4.50.

An experimental investigation was performed to study the deposition of calcium hydroxy apatite in boiler furnace tubes and on nuclear steam generator tubing. The investigation was run in a high-pressure loop at pressures up to 10 MPa. The heat transfer surface was run at densities of heat flow rates up to 0.9 $MW \cdot m^{-2}$ and boiling. The deposition rate constants thus recorded were in the range 0.1 to 100 $\mu m \cdot s^{-1}$. Increments in the density of heat flow rate and in the water temperature increased the deposition rate sharply. No clear dependence of electrical conductivity or pH were traced. Sodium polyacrylate had a marked inhibiting effect on the deposition. The deposition was recorded by measuring the gamma radiation from ^{47}Ca, which was used as a tracer isotope. (auth)

3219 (BNWL-1784) BUCKLE: AN ANALYTICAL COMPUTER CODE FOR CALCULATING CREEP BUCKLING OF AN INITIALLY OVAL TUBE. Pankaskie, P. J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1974. Contract AT(45-1)-1830. 105p. Dep. NTIS $5.45.

BUCKLE is a one dimensional computer code compiled to calculate the change in ovality, of an initially oval, closed end finite length tube, as a function of time, temperature, neutron flux and uniform external pressure. The basic concept employed in BUCKLE is that a tube, which is slightly out-of-round, tends to become more out-of-round with time when subjected to net uniform external pressures. The timewise change in ovality occurs as a consequence of creep deformations arising from tangential compressive and tangential bending stress produced by uniform external pressures acting on an initially oval tube. Standard tube specifications all permit a small amount of ovality in each tube. This aspect provides a realistic basis for the use of ovality-stress-creep relationships for calculating the time dependent conditions for buckling instability which are more commonly known as creep buckling or creep collapse. Although the analytical mechanics model is one dimensional, stress biaxiality and material anisotropy effects are indirectly included through the selection of the stress coefficient in the creep equation model. (TFD)

3220 (UCRL-51237) TECHNICAL DEVELOPMENTS, JULY 1969-JUNE 1970. Lerner, S.; Weis, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Jun 1972. Contract W-7405-eng-48. 143p. Dep. NTIS $10.25.

A brief description of several technical developments and concepts reported to the USAEC by the Lawrence Livermore Laboratory is presented. These developments and concepts are considered within the scope of the Technology Transfer Program. The items fall into the following categories: charged particle beam devices, electronics, lasers, materials fabrication, measurement, Plowshare Program, and miscellaneous. (TFD)

3221 (UCRL-51633) CONSTRUCTION AND OPERATION OF A LARGE VOLUME NOBLE GAS PURIFIER. Stribling, S. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Aug 1974. Contract W-7405-eng-48. 14p. Dep. NTIS $4.00.

A closed-loop, noble gas purification system capable of reducing the total active gas impurity concentration (e.g. H_2, O_2, N_2, CH_4, H_2O) of 400 dm^3 (STP) of commercially available research grade xenon to ~1.5 ppM is described. The system has reduced the total active gas contamination of 200 dm^3 (STP) of recovered xenon from ~200 ppM to ~1.5 ppM. In addition to supplying ultrapure bottled gas to 10 MPa, the purifier may be connected directly to an experiment. In this latter mode, the experimental apparatus becomes part of the purification loop and is cleaned concurrently with the gas. (auth)

3222 HYPERCRITICAL ONCE-THROUGH VAPOR GENERATORS IN COUNTER FLOW WITH AND WITHOUT TWISTED TAPES. Cumo, M. (CNEN, Rome); Farello, G. E.; Ferrari, G.; Maciuca, C. Termotecnica (Milan); 28: No. 9, 483-490(Sep 1974).

The influence of swirl flow in once-through vapor generators was examined in the near critical region. Experiments were performed with indirect heating of Freon 12, flowing upward in a central duct, by water flowing downward in an annular gap, to avoid the shortcomings of the direct Joule heating of the ducts and to approximate better actual situations. Pressures slightly below and above the critical value have been tested, in identical reference situations, with and without twisted tapes in the Freon duct. The total exchanged power, in the critical region, increases slightly in the swirl flow with respect to the straight flow when the critical Freon temperature is reached at the outlet. But the gain attained with the insertion of the twisted tape is so little that it does not appear worthwhile, considering the shortcomings as plant complications, fear of fretting corrosion, increasing of costs and pressure drops, etc. (auth)

3223 STATIC, STABILITY, AND DYNAMIC ANALYSIS OF SHELLS OF REVOLUTION BY NUMERICAL INTEGRATION - A COMPARISON. Svalbonas, V. (Grumman Aircraft Engineering Corp., Bethpage, N. Y. (USA)); Key, J. (National Aeronautics and Space Administration, Huntsville, Ala. (USA). George C. Marshall Space Flight Center). Nucl. Eng. Des.; 27: No. 1, 30-45 (1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The use of numerical integration for the analysis of practical shell-of-revolution structures was documented almost simultaneously in the United States by three independent groups of researchers (Cohen, Kalnins, Mason et al.). These early efforts have been refined, reformulated, and increased in scope and applicability to become major program systems (SRA, Kalnins, STARS). While all three programs utilize basically the same mathematical formulation for integrating the shell differential equations, the matrix solution procedures from this point are basically different. The purpose of this paper is twofold, as follows: (1) to present the differences in solution procedures of the largest system (the Grumman - NASA STARS) from the other two, and point out the inherent advantages of this approach; and (2) compare the numerical integration procedure, as utilized in the STARS, with finite difference and finite element procedures, noting the relative advantages of each in the analysis of shells of revolution for static, buckling, and dynamic loadings. To fulfill the above purpose, a brief review of the numerical integration procedure for the analysis of shells of revolution is presented, and the matrix solution procedures of the SRA, Kalnins, and STARS programs are contrasted. The limitations imposed by the relative procedures are discussed. The unique formulation utilized by STARS for the solution of stability and vibration problems, and its advantages, are discussed in detail. The STARS program's analytical capabilities, capacity, and user options are compared with those of other major systems utilizing either finite differences or finite elements for the analysis of shells of revolution. Comparisons are made in terms of program size, program accuracy, number of degrees of freedom required for analysis, ease of idealization and user inputs, limitations imposed on analysis capability or output, running time, and so forth. All advantages and differences are demonstrated by use of solutions for realistic shell problems in the areas of statics, stability (including dead and live load distributions), vibrations, and dynamic response of shells subjected to time-dependent loadings. (auth)

3224 FRACTURE INITIATION AND PROPAGATION IN A CYLINDRICAL SHELL CONTAINING AN INITIAL SURFACE FLAW. Erdogan, F.; Ratwani, M. (Lehigh Univ., Bethlehem, Pa. (USA)). Nucl. Eng. Des.; 27: No. 1, 14-29(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The paper deals with the problem of fracture initiation, propagation, and arrest in a pressurized cylindrical vessel which contains an initial surface flaw, is discussed. It is assumed that the flaw has the most unfavorable geometry and orientation, namely, it is a relatively long part-through axial crack. First the problem of a crack which is sufficiently 'shallow' so that the plastic deformations are confined to the neighborhood of the crack border and part of the net section near the inner wall is still elastic is considered. The plasticity-corrected stress intensity factor obtained from this analysis is the controlling load factor in failure considerations related to fatigue crack propagation, stress corrosion cracking, and static fracture (with the use of fracture toughness, COD, or a K_R curve-type failure criterion). The problem of relatively deep crack with fully-yielded net ligament is then considered. Plastic deformations are also assumed to spread around the crack ends through the entire wall thickness. A perfectly plastic strip model (with an eight order shell theory) is used to calculate the plastic zone size and the crack opening displacement along the crack border. Previous studies indicate that for the analysis of the type of stable and subsequent unstable crack propagation problems under consideration, the crack opening displacement δ is a more suitable load factor than the stress intensity factor K, or the crack extension force G. Thus, in this paper a 'crack opening stretch' type material characterization is used. After the rupture of the net ligament under the crack, the axial crack propagation is accompanied by the depressurization of the vessel caused by leakage. From this point on the fracture problem is coupled with the related fluid mechanics or gas dynamics problem where the primary unknowns are the pressure and the crack length as functions of time. In the present study it is assumed that the volume of the vessel is finite and the crack propagation is quasi-static (this assumption, which is necessary to keep the problem within manageable proportions, is justified by the relatively low crack velocities, i.e. $\nu_c < 0.25\ c_2$, c_2 being the shear wave velocity). (auth)

3225 SOME CONSIDERATIONS FOR THE EVALUATION OF FINITE ELEMENT MODELS. Argyris, J. H.; William, K. J. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen). Nucl. Eng. Des.; 28: No. 1, 76-96(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1974).

Two topics are discussed within the context of finite element discretization of structures, the evaluation of stiffness properties and the computation of stresses. In the first part different polynomial expansions are studied on a typical example in regard to accuracy and efficiency. Then an attempt is made to improve the stiffness of the displacement model, e.g., by direct approximation of the strain field as opposed to its derivation from the displacement field. Alternatively, the order of numerical integration is reduced, the effect of which is then compared with the mixed model above. In the second part an integral procedure is developed for the direct approximation of element stresses as opposed to the local stress computation in which the stresses are derived from the displacement field. Numerical examples are then presented to illustrate the effects of different stress evaluation techniques for displacement models. (auth)

3226 CONSTITUTIVE MODELING AND NUMERICAL SOLUTION OF FIELD PROBLEMS. Pister, K. S. (California Univ., Berkeley (USA). Structural Engineering Lab.). Nucl. Eng. Des.; 28: No. 1, 137-146(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1974).

In formulating phenomenological models and developing solution algorithms for problems in continuum and structural mechanics, experience with the behavior of actual systems has always played an important guidance role for the engineer concerned with predicting performance of feasible alternatives. By exercising control over various system parameters the engineer attempts to minimize the difference between a desired objective and a predicted approximation thereof. Constitutive modelling of mechanical behavior of materials is an example typical of this activity. In this paper constitutive modeling of an isolated material element is discussed as an identification problem. The mathematical structure of the problem is discussed and limitations arising from experimental sources, measurement errors, and material nonlinearity are noted. As a consequence of the structure of the problem it is shown that an inverse initial-boundary value problem must be considered, in which material identification and numerical analysis of this problem must proceed simultaneously. This paper discusses a discretized form of the inverse problem and illustrates the methodology by citing a number of examples in the literature which appear as special cases of the present treatment. (auth)

3227 SHAKEDOWN ANALYSIS OF ELASTIC-PLASTIC STRUCTURES. Sawczuk, A. (Polska Akademia Nauk, Warsaw). Nucl. Eng. Des.; 28: No. 1, 121-136(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1974).

Behavior of elastic-plastic structures under repetitive and fluctuating loads is considered in this paper. Plastic deformation either stabilizes after a finite number of cycles or continues during the cycling. In the first case the structure is said to have shaken down to the boundary at the loading program. If plastic deformation does not stabilize an elastic-plastic structure becomes unserviceable due to either alternating plasticity when yielding occurs repeatedly in the opposite senses or accumulation of plastic strains and progressive increase of permanent displacements. This paper attempts to survey the shakedown theory, including the accommodation of a structure to the prescribed loading range as well as inadaptation and unserviceability. The notion of shakedown, incremental collapse, ratchetting and alternating plastic deformation are first illustrated with examples. The fundamental theorems on shakedown and inadaptation are presented next, attention being directed to generalizations of the classical Melan and Koiter theorems. Applications of the theorems are given. Available methods for determining the shakedown range on generating self-equilibrated stress fields are discussed. Special techniques applicable to problems involving both dead and fluctuating loads are invoked. Recent studies accounting for inertia forces, geometrical changes, material hardening, variation of material properties with temperature, displacement assessment, etc. are referred to. (auth)

3228 EFFICIENT UTILIZATION OF WELDING EQUIPMENT WHILE ERECTING CONVENTIONAL AND NUCLEAR POWER PLANTS. Loshakov, A. M.; Foryashchenko, Yu. N.; Gracheva, K. N. Energ. Stroit.; No. 2, 32-36(1973). (In Russian).

In an installation of a 300,000 kW power source, no more than 28 to 30 units should be used. The maximum number of operating sources should be 17 to 19. The average coefficient of reserve for installation conditions is taken as 25%, the maintenance reserve as 10%, and for equipment, considering the work of one welder at several separate locations, as 15%. The optimum number of power sources per electric welder is 1.3 to 1.4. Data on the dynamics of welding capacities in installation, the presence of power sources, the ratio between the number of sources and the electrowelders, the cost of electrodes, and equipment use are presented. (tr-auth)

3229 FLOW CHECK DEVICE FOR LIQUID-METAL LOOPS. Ogorodnikov, S. N.; Orlov, R. V.; Khomich, R. N. Sov. J. At. Energy (Engl. Transl.); 36: No. 2, 204-205(Feb 1974).

Translated from At. Energ. (USSR); 36: No. 2, 159-160(Feb 1974).

Stringent requirements are placed on flow-check devices used in plasma accelerators operating under severe thermal stress and in highly corrosive environments. The basic design of a flow-check device for liquid-metal loops is given. The device operates by freezing the working fluid. (TFD)

3230 SOME EXPERIENCE ON A MODEL DEVICE RUNNING WITH LIQUID SODIUM. Matal, O.; Tomes, V.; Konecny, A. (First Brno Engineering Works). Jad. Energ.; 20: No. 8, 268-271(Aug 1974). (In Czech).

The article gives a brief outline of a method of connection, preparation, and setting in motion, dismounting and purification of the model device IBZKGVNT in frictional and wear tests of some materials and bearings in liquid sodium. (auth)

Lasers

Refer also to abstract 3096.

3231 (AD-773031/OGA) STUDY OF NEW CHEMICAL LASER SYSTEMS. Final Report, 1 January-28 December 1973. Eckstrom, D. J.; Edelstein, S. A.; Benson, S. W.; Black, G.; Luria, M. (Stanford Research Inst., Menlo Park, Calif. (USA)). 28 Dec 1973. Contract DAAH01-73-C-0444. 56p. NTIS $3.75.

Quantitative experimental studies were carried out to measure the degree of electronic state excitation produced in reactions of metal atoms with various oxidizers. The objective is to discover reactions that could lead to an electronic transition chemical laser. Flames of the alkaline earth metals Mg, Ca, Sr, and Ba reacting with F_2, ^{12}C, NO Cl, and N_2O have been studied at pressures from one to three torr using an evaporation oven as the metal atom source. Diffusion flames of encapsulated metals, consisting of the carbonyls or alkyls of Ni, V, Al, Zn, and Sn, reacting primarily with F_2 were studied at pressures from 0.5 to 5 torr. The Ba + N_2O reaction was found to have a photon yield of 10%, and is a good candidate for laser studies. Emission spectra are reported and discussed. (GRA)

3232 (AD-775314) Q-SWITCHING AND MODE-LOCKING THE Nd^{3+} GLASS LASER WITH THE NICKEL DITHIENES. Magde, D.; Bushaw, B. A.; Windsor, M. W. (Washington State Univ., Pullman (USA). Dept. of Chemistry). Jan 1974. Contract N00014-68-A-0410-0003. 6p. NTIS $3.00.

The compound bis-(4-dimethylaminodithiobenzil)-nickel (BDN) was shown to be a photochemically stable saturable absorber suitable as a Q-switch for Nd^{3+}-glass lasers. (GRA)

3233 (AD-775577) HIGH POWER DYE LASERS. Annual Report, 1 January 1973–28 February 1974. Clobes, A. R.; Ferrar, C. M.; Glenn, W. H.; Ladd, G. L.; Morey, W. W. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). 28 Feb 1974. Contract N00014-73-C-0284. 81p. NTIS $4.00.

The report describes the operation of a high power, repetitively pulsed, flashlamp pumped dye laser. To date an average power of 39 watts at a repetition rate of 100 Hz has been obtained. The techniques employed should be scalable to higher power and higher repetition rate. Experiments to produce frequency sweeping of the laser during the pulse are described. Altimate flashlamp geometries are discussed as are experiments to achieve better spectral matching of the lamp output to the dye. (auth)

3234 (AD-777143) QUANTITATIVE THEORY OF AN ELECTRON-BEAM-EXCITED CARBON MONOXIDE GAS DYNAMIC LASER: 1. Formulation. Chen, C. C. (Rand Corp., Santa Monica, Calif. (USA)). Oct 1973. Contract F44620-73-C-0011. 72p. (R-1321-PR). NTIS $3.75.

A new concept for a high power CO gas dynamic laser, coupling a supersonic expansion nozzle and an electron beam preionizer-sustainer discharge system, that promises both the high efficiency of an electrically pumped CO GDL and the high power of a thermally pumped CO GDL. The superiority of the proposed laser to existing CO lasers for atmospheric application is shown. General operational characteristics of a CO laser, and a state of the art review of the various types of continuous-wave CO lasers are given. The principle of anharmonic (V-V) pumping is presented, and the excitation and inversion mechanisms of these CO lasers are described. Finally, a quantitative theory is formulated to describe the new laser, and a frozen flow approximation of the problem is proposed. (auth)

3235 (AD-777521) STUDY OF SEMICONDUCTOR LASER MODAL FIELDS AND THEIR RADIATION PATTERNS. Final Report, 4 May 1971–31 January 1974. Butler, J. K.; Voges, R. C.; Sanzgiri, S. M.; Zoroofchi, J.; Wang, C. S. (Southern Methodist Univ., Dallas, Tex. (USA)). 28 Feb 1974. Contract DAAK02-71-C-C-0263. 115p. NTIS $8.75.

The objectives of this program were to analyze the index of refraction of various regions of lasers as a function of the aluminum concentration so that lasers can be synthesized with optimum radiation patterns in the sense that the power beamwidth will be minimized; to produce design curves showing the beamwidth for various laser structures; and, to investigate laser structures which produce waveguide modes giving the smallest possible radiation pattern divergence. (GRA)

3236 (AD-777692) GENERATION AND DETECTION OF COHERENT AND INCOHERENT ELECTROMAGNETIC RADIATION. Final Report, 15 July 1968–14 July 1973. (Rice Univ., Houston, Tex. (USA)). 14 Jul 1973. Contract N00014-68-A-0503. 11p. NTIS $4.00.

The report briefly reviews research areas which were supported by this contract. Research and development work on tunable coherent light sources, picosecond laser pulses, laser pulse measurement and mode locking theory, techniques for submillimeter generation and detection, development of gamma-ray telescopes, infrared detection, theoretical studies of gamma-ray optics, and experimental studies in vacuum uv, x-ray and gamma-ray optics is discussed. (auth)

3237 (AD-778460) GENERATION OF TUNABLE COHERENT RADIATION IN THE MILLIMETER AND SUBMILLIMETER RANGE FOR USE AS SOURCES AND DETECTORS. Final Report. Leopole, L.; Gregory, W. D. (Georgetown Univ., Washington, D. C. (USA). Dept. of Physics). Mar 1974. 29p. (AFOSR-TR-74-0683). NTIS $3.25.

The transmission characteristics of thin Al films (about 200A) for 100 GHz radiation were measured. The superconducting films were put into various non-equilibrium states by illuminating them with an Ar laser where power was changed from zero to 500 MW. The conclusion of the work is that the films are not heated in agreement with previous results. (auth)

3238 (IPP-IV-69) SUBSONIC HIGH POWER CW-HF LASER. Proch, D.; Pummer, H.; Wanner, J. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Jul 1974. 19p. (In German). Dep. NTIS (US Sales Only) $4.00.

A continuously operating hydrogen fluoride laser, operating in the subsonic flow regime, is described. Details of the experimental setup are given. The maximum power output is 40 watts with a stability of 3%. Spectrum measurements show the appearance of up to 14 different vibrational-rotational transitions, belonging to the P_{2-1} and P_{1-0} bands, respectively. The influence of gas temperature on the relative intensities of the spectral lines is investigated. (auth)

3239 (IPP-IV-74) PULSED HIGH POWER IODINE LASER AT IPP. Brederlow, G.; Hohla, K.; Witte, K. J. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Jun 1974. 15p. (CONF-740439-3). Dep. NTIS (US Sales Only) $4.00.

From 7th European conference on plasma production by high power lasers; Garching, F. R. Germany (22 Apr 1974).

The basic features of the iodine laser as a high power laser are reported. The scaling laws for the dimensions of an iodine laser amplifier are given. The two laser systems Asterix II (100 J/1 nsec) already existing and Asterix III (1 kJ/1 nsec) being constructed are described in detail. (auth)

3240 (KFKI-74-28) INTERFEROMETRIC LINEWIDTH MEASUREMENTS ON THE 5378 A LINE OF THE He–Cd ION LASER. Salamon, T.; Lorincz, E.; Csillag, L.; Rozsa, K. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 9p. Dep. NTIS (US Sales Only) $4.00.

The linewidths 53 ± 18 MHz and 47 ± 12 MHz on $\lambda = 5378$ Å were measured of a hollow cathode, dc-excitation, Cd ion laser at pressures 20 and 60 torrs, respectively. This means that the laser is operating in single mode within a large pressure range. Interferometric measurements on the spontaneous transition have indicated large homogeneous broadening which has been accepted as the main reason of the single mode laser generation. (auth)

3241 (LA-5659) STABILITY AND NONEXPLOSIVE HYDROGEN FLUORIDE PRODUCTION IN ATMOSPHERIC-PRESSURE HYDROGEN–OXYGEN–FLUORINE MIXTURES. Getzinger, R. W. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 13p. Dep. NTIS $4.00.

The behavior of atmospheric-pressure mixtures of H_2, O_2, and F_2 at ambient temperatures was studied to determine conditions under which the reagents can be combined nonexplosively. An HF probe laser monitored the formation of HF during the mixing process and for the following 30 min, under conditions where < 5% of the reagents had disappeared. Hydrogen fluoride formed relatively "promptly" during mixing and at an essentially constant rate thereafter. Evidence is presented that heterogeneous reaction steps significantly influence the slow deterioration of prepared mixtures. (auth)

3242 (SAND-74-5550) COMPUTER-BASED DIAGNOSTICS FOR THE SANDIA FOUR-BEAM LASER. Boyer, W. B.; Davis, R. F.; Krone, J. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 16p. (CONF-741001-2). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

The Sandia Four-Beam Laser facility is briefly described and the need for diagnostic instrumentation is discussed. The on-line computer system which supports this instrumentation is then described. Significant problems affecting the design of the instrumentation equipment are discussed, followed by descriptions of the actual equipments which have been built and the associated interfacing techniques. (auth)

3243 (UCID-16550) LASER INTENSITY MEASUREMENT. Saroyan, R. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Aug 1974. Contract W-7405-Eng-48. 48p. Dep. NTIS $5.25.

A method for obtaining laser intensity measurements was developed and experimentally tested. A photographic plate is used to record the far-field laser intensity distribution. By using a multiple image technique the image is self calibrated. The computer program that processes the photographic density data produced by a scanning microdensitometer is also described. The program provides relative and absolute intensity distribution information. Data produced by this method are presented. (auth)

3244 (UCID-16620) PROSPECTS FOR GASEOUS RARE EARTH LASERS. Krupke, W. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Sep 1974. Contract W-7405-eng-48. 28p. Dep. NTIS $4.50.

It is shown that many of the characteristics of the RE-trihalides, RE-Al-Cl complexes, and $RE(thd)_3$ systems are supportive of laser action. It is pointed out that consideration should not be limited to Nd(3+) alone, since dynamically, other ions radiating in the visible (Ce, Eu and Tb) with low lying 4f → 5d pump bands may succeed where Nd fails. One should probably investigate the Nd-Al-Cl complexes first, since they seem reasonably tractable. $AlCl_3$ additives to liquid phosphor oxychloride did not deactivate the $4F(^3/_2)$ manifold, and presumably will act similarly in the vapor phase. Other metal halides can also be utilized, (for example, $GaCl_3$ has lower melting and boiling points than $AlCl_3$) perhaps providing greater optical transition strengths, greater RE vapor pressures at a given temperature, or lower background pressures for a given storage. (auth)

3245 (UCRL-75631) DAMAGE STUDIES AT 1.06 μm WITH 100 TO 200 PS PULSES. Leppelmeier, G. W.; Finkelstein, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jun 1974. 11p. (CONF-740524-5). Dep. NTIS $4.00.

From ASTM Workshop; Boulder, Colorado, USA (22 May 1974).

Studies were conducted of the damage threshold at 1.06 μm of multi-layer dielectric films used as polarizing beamsplitters, mirrors, and anti-reflection coatings, $K(H_x \ldots D_{2-x})PO_4$, several high Verdet constant glasses, and micromachined silver. The laser pulse used had less than 4% spatial and temporal ripple. Pulse energy of up to 1 joule permitted using a collimated beam. Damage thresholds in the range 1-5 J/cm^2 were obtained. (auth)

3246 (UCRL-76062) RARE EARTH LASERS. Weber, M. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1974. 11p. (CONF-741002-11). Dep. NTIS $4.00.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

A tabulation of rare-earth laser ions, types of hosts employed, and rare earths used as sensitizer ions is given. Some brief comments regarding the various types of rare-earth lasers are also given. The spectral range of these lasers extends from 0.5 to 3.0 μm. The operating wavelengths of some selected rare-earth lasers are listed. (MOW)

3247 (Y-DA-5993) SURFACE CHARACTERISTICS OF DIAMOND TURNED LASER OPTICS. Sladky, R. E.; Arnold, J. B.; Corey, H. S.; Steger, P. J. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1974. Contract W-7405-eng-26. 26p. (CONF-740943-1). Dep. NTIS $4.50.

From sixth annual conference on surface studies; Oak Ridge, Tennessee, USA (10 Sep 1974).

The high-energy laser program requires large diameter metal mirrors capable of superior optical performance. One of the methods of obtaining these mirrors is by diamond turning, which can be described as superfinishing a metal surface by single-point tooling. Flat and curved surfaces from one-cm to 40-cm diameter with a surface finish better than 25 angstroms RMS have been produced in Y-12. The surface finish, light scattering, reflectivity, and absorptivity of many of these surfaces have been measured by several laboratories. Instrumental methods and a summary of the results will be presented. (auth)

3248 LASER GENERATION SYSTEMS WITH NON-LINEAR OPTICAL MEDIUM. Klejman, H. Elektronika; 15: No. 6, 241-245(1974). (In Polish).

The systems for multiplication and mixing of laser beam frequencies and arrangements with stimulated Raman scattering are described. Nonlinear optical phenomena and nonlinear crystals are briefly characterized. (auth)

3249 ELECTRON ENERGY IN THE CO LASER PLASMA. Vasiliu, V. (Inst. of Atomic Physics, Bucharest); Novgorodov, M. Z.; Sviridov, A. G.; Sobolev, N. N. Stud. Cercet. Fiz.; 26: No. 2, 165-174(1974). (In Rumanian).

The energy distribution function of electrons in a CO laser plasma containing mixtures, e.g., ($CO-O_2-N_2-He$) or ($CO-O_2-He$), under gas circulation conditions or not and in a liquid nitrogen cooled discharge or uncooled was determined. The distribution function so obtained exhibits a non-Maxwellian trend. Some experimental data concerning the aforementioned distribution are given by plotting the sounder current second derivative versus discharge voltage in the version of the second harmonics method. (auth)

3250 GAIN AND LINEWIDTH STUDIES OF A HIGH PRESSURE CO_2 LASER. Wright, D. W. Ithaca, NY; Cornell Univ. (1974). 81p. University Microfilms Order No. 74-17,694. Thesis (Ph. D.).

A compact, durable high pressure CO_2 laser was built. The laser had peak output energy of 2.5 joules and pulsed power of greater than 5 megawatts. The gain of this laser was measured on 33 rotational lines. From the gain distribution vibrational populations at the point of peak gains were computed. The values were 1.2×10^{17} cm.$^{-3}$ for the 00°1 population and 0.58×10^{17} cm.$^{-3}$ for the 10°0 population. Also a rotational temperature of T_r = 364°K was computed from the same data. The laser was operated with a tilted internal Fabry–Perot interferometer. The interferometer could be scanned over the homogeneously broadened linewidth of the laser medium. The high pressure laser was assumed to operate on a single longitudinal mode of the laser cavity. The nature of the gain in a homogeneously broadened medium tends to suppress all modes except the one with the highest gain. Some mode to mode tuning with the internal scanning interferometer was observed at the winds of the homogeneously broadened line. The pressure broadened linewidths for the high pressure laser were measured under conditions of oscillation on 26 rotational transitions in the 10.6 micron band. The narrowing of the oscillation linewidth with increasing J value was observed and found to narrow only slightly more rapidly than would be predicted from low pressure absorption measurements. (Diss. Abstr. Int., B)

3251 INFLUENCE OF HYDROSTATIC PRESSURE ON THE EMISSION SPECTRA OF $Pb_{1-x}Sn_xSe$ LASERS. Zasavitskii, I.I.; Matsonashvili, B.N.; Pogodin, V.I.; Shotov, A.P. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Semicond. 8: No. 4, 467-470 (Oct 1974).

An investigation was made of the influence of hydrostatic pressure on the 77°K emission spectra of pulsed injection lasers based on the ternary compound $Pb_{1-x}Sn_xSe$ with x=0.085. When the pressure was increased from atmospheric to 1.14 kbar, the laser emission band shifted from 13.5 to 15.2μ. The relative change in the emission wavelength was about 13%. The individual modes also shifted under pressure. The pressure coefficients of the whole emission band and of the individual modes were obtained. (auth)

3252 CAUSES OF ARCING IN cw CO_2 CONVECTION LASER DISCHARGES. Nighan, W.L.; Wiegand, W.J. (United Aircraft Research Laboratories, East Hartford, Connecticut 06108). Appl. Phys. Lett. 25: No. 11, 633-636 (1 Dec 1974).

The factors causing glow–to–arc transition in volume–dominated molecular gas discharges have been analyzed in terms of the collisional processes taking place in the plasma. It has been shown that arcing can be initiated by the growth of disturbances in either vibrational or translational temperature. Calculations indicate that thermal and/or vibrational instabilities will occur for most conditions of importance to high–power cw CO_2 convection lasers, and that the growth time for these instabilities is typically on the order of 1 msec. (auth)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstracts 4067, 4069, 4075, 4842, and 4852.

3253 (BMFT-FB-T-74-29) DEVELOPMENT OF SUPERCONDUCTING HIGH-FIELD MAGNETS FOR FLUX DENSITIES OF MORE THAN 10 TESLA. Kuckuck, H. (Bundesministerium fuer Forschung und Technologie, Bonn (F.R. Germany); Zentralstelle fuer Luft- und Raumfahrtdokumentation und -information, Muenchen (F.R. Germany)). Jul 1974. 64p. (In German). INIS. 24 figs.; 13 refs. With abstract in English and German.

The aim was to meet the basic needs prerequisite to the commercial production of magnet coils for flux densities of 10 to 15 Tesla. Special attention was given to the combination of niobium–tin conductors in the high-field section with niobium–titanium conductors in the low-field section of the magnet. The main difficulties arose in connection with the application of the niobium–tin superconductors consisting of a substrate strip on which the extremely brittle superconducting layer is deposited. When the conductor material originally selected proved unsuitable for the industrial production of large magnets, tests were carried out on conductors made in the laboratory by the vapor-phase process. This work demonstrated the need to clarify problems relating to basic aspects. (auth)

3254 (BNL-tr-575) SUPERCONDUCTING AC POWER TRANSMISSION CABLE OF FLEXIBLE DESIGN WITH NIOBIUM–TIN STRIP CONDUCTORS. Voight, H. Translated by S. J. Amoretty from Elektrotech. Z., A; 94: No. 5, 256-260(1973). 22p. Dep. NTIS $4.25.

The development of a flexible superconducting cable using Nb_3Sn is discussed. Its use as a superconducting ac power cable is theoretically discussed in terms of its hysteretic losses. The use of these cables in three-phase transmission is also described. The overload capacity of the Nb_3Sn strip conductors is discussed in terms of the critical field and the magnetic field of the conductors. (MOW)

3255 (LA-UR-74-1145) ECONOMIC AND SYSTEM ASPECTS OF A SUPERCONDUCTING MAGNETIC ENERGY STORAGE DEVICE AND A DC SUPERCONDUCTING TRANSMISSION LINE. McDonald, T. E.; Hassenzahl, W. V. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 2p. (CONF-741130-1). Dep. NTIS $4.00.

Preliminary cost studies have been made in an effort to gain an indication of the economic viability of superconduction energy storage and dc power transmission. A summary of results is given for the cost of twin-lead, coaxial cable, and single conductor transmission lines. Cost estimates are also summarized for various superconducting storage systems. (MOW)

3256 SIMPLE BRIDGE FOR DETECTION OF SUPERCONDUCTIVITY. Claeson, T.; Wingbro, T. (Department of Physics, Chalmers University of Technology, Fack, S–402 20 Gothenburg 5, Sweden). Rev. Sci. Instrum. 45: No. 11, 1478-1479 (Nov 1974).

A very simple instrumentation for superconductivity detection down to the millikelvin range is described. (auth)

3257 NOISE LIMITATIONS ON MEASUREMENTS MADE WITH SLUGS. Gallop, J. C. (National Physical Lab., Teddington, Eng.). J. Phys., E (London); 7: No. 10, 855-859(Oct 1974).

Experimental results on noise figures obtained with DC biased double junction quantum interferometers are presented. A new type of adjustable double junction is described and its performance is compared with both direct coupled and transformer coupled SLUGS. With the measurement system used a magnetic flux resolution of 4×10^{-20}Wb has been achieved within a bandwidth of 1 Hz. Even with this very high resolution the limit appears to be set by noise originating in the room temperature amplifier rather than by noise intrinsic to the quantum interferometer. (auth)

3258 EXPERIMENTS ON FLUX JUMPS IN SUPERCONDUCTING TAPES. Shimamoto, S. (CEN de Saclay, Gif-sur-Yvette, France). Cryogenics; 14: No. 10, 568-573(Oct 1974).

Experimental results are reported on flux jumps measured by means of search coils on a short sample superconducting tape in an increasing field perpendicular to its surface. The superconducting material, the stabilizing copper thickness, the cooling condition, and the transport current have been varied during the tests. A small coil wound with a superconducting tape was also tested in an increasing perpendicular field. The flux jumps measured here are classified on the basis of their characteristics observed in the experiment. (auth)

3259 SPECTRAL DENSITY OF VOLTAGE FLUCTUATIONS IN POINT, SUPERCONDUCTING CONTACTS. Likharev, K. K.; Semenov, V. K. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 4, 493-496(1974). (In Russian).

In order to estimate the limiting characteristics of units in which point superconducting contacts are used, it is necessary to explain the problem of the intensity of particular fluctuations in such contacts. An asymptotic expression for the voltage fluctuation spectrum, which is correct at a sufficiently small fluctuation intensity of an effective source had been obtained previously. The present study determines the spectral density of voltage fluctuations at an arbitrary intensity of the effective source of the noise current, and also accurately delineates the limits of applicability of the results of the previous study. It is assumed that the noise is thermal. The noise of the effective source is considered to be white in this case. (SJR)

3260 AC LOSSES IN A COMPOSITE TUBULAR SUPERCONDUCTOR FOR POWER TRANSMISSION. Baylis, J. A.; Lewis, K. G.; Male, J. C.; Noe, J. A. (Central Electricity Research Labs., Leatherhead, Eng.). Cryogenics; 14: No. 10, 553-556(Oct 1974).

AC losses have been measured as a function of current and temperature in a 63.5 mm diameter niobium/copper composite tube, forming the inner conductor of a coaxial superconducting transmission line. The conductor has a 2.6 mm thick substrate of high-conductivity copper with a 50 μm thick niobium surface layer bonded by co-extrusion and cold-drawing. Closed-cycle refrigeration allowed losses to be measured as a continuous function of temperature between 4.4 and 8.0 K for surface current densities between 23 and 89 A mm^{-1}. Losses were less than 0.1 W m^{-2} at 5 K for surface current densities less than 50 A mm^{-1}, and obeyed approximately the empirical relation: loss $\propto h^7$ where h is the ratio of surface current density to H_{c2} for the superconductor. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 3218, 3222, 3438, 3439, 5225, 5226, 5229, 5230, 5271, and 5284.

3261 (AE-497) EFFECT OF WALL FRICTION AND VORTEX GENERATION ON RADIAL VOID DISTRIBUTION: THE WALL-VORTEX EFFECT. Rouhani, Z. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1974. 35p. Dep. NTIS (US Sales Only) $4.75.

Arguments are presented to prove the existence of rolling vortices in two-phase flow. In the liquid phase they will appear in a boundary layer near the walls while in the continuous vapor phase they will occur near the interface with a liquid film. The intensity and size of these vortices are expected to depend on the local velocity gradients normal to the walls. A discussion is given of the interaction between the rotational field associated with such vortices and bubbles in liquid flow or droplets in vapor flow. This interaction is called the wall-vortex effect. It appears that several, apparently unrelated, phenomena observed in two-phase flow systems may be interpreted in terms of this mechanism. Among these are: radial void peaking near the walls; slip ratios less than unity observed even in vertical upward flow; reduced droplet diffusion near the liquid film; reduced vapor mixing between subchannels at low steam qualities; and accelerated flashing process in flow of depressurized liquid. Finally, a comparison with the well-known Magnus effect is also included. (auth)

3262 (AECL-4752(Add.)) CALCULATION OF HEAT-TRANSFER CRISIS FOR ANNULAR TWO-PHASE FLOW OF A STEAM-LIQUID MIXTURE THROUGH AN ANNULAR CHANNEL. Addendum. Kirillov, P. L.; Smogalev, I. P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Jun 1974. Translation by G. Phillips of FEI-297. 3p. Dep. NTIS (US Sales Only) $4.00.

An addendum is presented to the original report (FEI-297, NSA abstract 28:20986) that contains the author's reply to various points raised subsequent to publication of the report. In the original report formulas were derived for the calculation of heat transfer crisis in annular channels during heating on one or two sides. (RCK)

3263 (BNL-tr-572) CURRENT CONCEPTS OF THE MECHANISM OF NUCLEATE BOILING OF LIQUIDS. Labuntsov, D. A. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). [nd]. Translation by S. J. Amoretty of the Introductory Paper in a Collection of Papers Entitled "Heat Transfer and Vapor Dynamics," Nauka, Moscow, 1974. 34p. Dep. NTIS $4.75.

An analysis of the literature pertaining to the mechanism and physics of nucleate boiling is presented. (TFD)

3264 (CONF-740925-5) AXIAL PROPAGATION OF FREE SURFACE BOILING INTO SUPERHEATED LIQUIDS IN VERTICAL TUBES. Grolmes, M. A.; Fauske, H. K. (Argonne National Lab., Ill. (USA)). 1974. 5p. Dep. NTIS $4.00.

From 5th international heat transfer conference; Tokyo, Japan (3 Sep 1974).

A unique free surface boiling phenomenon has been observed as a result of rapid depressurization of an initially saturated or slightly subcooled stagnant liquid column in the absence of wall and bulk nucleation sites. Closeup high-speed photographs of water, refrigerant-11, and methyl alcohol in tubes from 0.2 to 15 in. diameter reveal that the initiation of violent free surface flashing (vapor plus entrained liquid) follows from the development of Marangoni-type surface waves. The rate of propagation of the flashing surface shows evidence of choked flow limitations and proceeds at a rate which is several orders of magnitude greater than surface evaporation (vapor only) alone. The onset of free surface flashing was found to be dependent upon both the degree of initial liquid superheat and the tube diameter. (auth)

3265 (CONF-740925-6) INCIPIENT SUPERHEAT IN A CONVECTIVE SODIUM SYSTEM. Henry, R. E.; Singer, R. M.; Quinn, D. J.; Jeans, W. C. (Argonne National Lab., Ill. (USA)). 1974. 6p. Dep. NTIS $4.00.

From 5th international heat transfer conference; Tokyo, Japan (3 Sep 1974).

Experimental measurements are reported for incipient boiling superheats in a convective sodium system. The results show that definitive evaluation of the incipient wall superheat requires a knowledge of the location of inception and detection of any entrained noncondensable gas bubbles. It is shown that, when history and gas solubility effects are properly accounted for, a reentrant cavity model is representative of the data. (auth)

3266 (CONF-740925-8) EXPERIMENTAL STUDY OF THE MINIMUM FILM BOILING POINT FOR LIQUID-LIQUID SYSTEMS. Henry, R. E.; Quinn, D. J.; Spleha, E. A. (Argonne National Lab., Ill. (USA)). 1974. 5p. Dep. NTIS $4.00.

From 5th international heat transfer conference; Tokyo, Japan (3 Sep 1974).

Film boiling data is reported for Freon-11, Freon-22, ethanol, and water boiling on a mercury surface. Measured heat fluxes and heat transfer coefficients are in good agreement with previous data. However, transition from film boiling occurs at much lower temperatures than would be expected from solid-liquid film boiling results. Film boiling of Freon-22 on water was attempted but transition occurred at much higher water temperatures than would be extrapolated from solid-liquid results. (auth)

3267 (ORNL-4987) SATURATED POOL AND FLOW BOILING STUDIES WITH FREON-113 AND WATER AT ATMOSPHERIC PRESSURE. Chapman, R. H. (Oak Ridge National Lab., Tenn. (USA)). Nov 1974. Contract W-7405-eng-26. 307p. Dep. NTIS $7.60.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

Research was undertaken to obtain an internally consistent data set from which convective flow boiling could be separated into its constituent pool boiling and forced-convection components and which could be used to test the adequacy of two commonly used correlations for predicting boiling heat transfer. Pool and flow boiling under saturation conditions at atmospheric pressure were studied using Freon-113 and demineralized water as test fluids. The same copper test surfaces, prepared by lapping with a 400-grit compound, were used for all the tests. Horizontal and vertical orientations were studied in the pool boiling facility; whereas the flow test facility was operated in the upflow mode. For the flow boiling tests, the mass flux was varied from 106,000 to 1,325,000 lb/hr·ft^2 with Freon and from 106,000 to 852,000 lb/hr·ft^2 with water. Convective boiling with Freon under annular flow conditions was investigated for a thermodynamic quality range of 2 to 8%, corresponding to a range of 4.1 to 0.94 for the Martinelli parameter. Most of the data were characterized as nucleate boiling; relatively few data were obtained under suppressed nucleation conditions. All the Freon flow boiling data were well correlated by the Rohsenow additive method. The annular flow boiling data were not predicted by the relation proposed by Chen. This was attributed to failure of the Zuber expression, on which Chen's relation is based, to describe the pool boiling results adequately. Aging effects of the copper boiling surface in the flow boiling tests with water (and to some extent in the horizontal pool boiling tests) caused excessive scatter and poor reproducibility in the data, negating correlation of the results with the Rohsenow additive technique. The data exhibited, however, the same general trends as observed with Freon. Measured boiling coefficients and photography provided some evidence that steam bubbles in the water stream flowing past the test surface interfere slightly with the boiling performance; this effect was not observed in the Freon tests. Degradation in performance appeared related to bubble size; the steam bubbles were observed qualitatively to be two to three factors greater in diameter than the Freon bubbles. No detectable surface orientation effect was found in the pool boiling studies with Freon. The results were well correlated by the Rohsenow pool boiling relation; the expression proposed by Zuber was inadequate. Measured coefficients for water boiling on vertical surfaces were found to be about 10% greater than those determined for horizontal surfaces. The results for pool boiling of water were reasonably well correlated with the Rohsenow expression but again the Zuber relation was deficient. Based on the results of this study, the Rohsenow additive method is recommended for use with Freon-113 over the investigated range of mass flux and thermodynamic quality. Its use for higher mass fluxes and qualities is probably justified. Although the formulation of Chen's correlation facilitates its use, it is not recommended for application with Freon-113 in the mass flux and quality range studied. The results of this study suggest that modifications to improve the nucleate boiling formulation are needed. Metallographic examination of specimens prepared identically to the boiling test surfaces revealed a highly irregular surface (on a microscopic scale). High magnification micrographs obtained by ordinary optical techniques and by use of an electron scanning microscope are included. Recommendations for further investigations are given. (auth)

3268 (RD/B/N-2760) HEAT TRANSFER AND PRESSURE DROP TESTS ON MULTI-START RIBBED SURFACES COVERING THE RIB ANGLE RANGE 0° TO 60°. Pirie, M. A. M. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Mar 1974. 40p. Dep. NTIS (US Sales Only) $5.00.

A series of heat transfer and pressure drop tests was carried out on large-scale transverse and multi-start ribbed surfaces in a smooth channel. A rib angle range of 0° to 60° was covered. The working fluid was pressurized CO_2 and a Reynolds number range of 5×10^5 to 3×10^6 was achieved. The influence of the smooth channel on the performance of the rough surface was eliminated by a calculation procedure known as 'transformation'. The method of Hall was used in which velocity and temperature traverses across the annular gap are made and the flow divided into two regions by a surface of zero shear. The position of this surface was accurately located from the smooth wall shear stress, which was estimated from the velocity traverse close to the smooth wall using Patel's log law expressions. It was shown that transformation methods based on the assumption that the maximum velocity and the zero shear positions coincide gave erroneous results for transformed values of Stanton number and friction factor. Using these methods the apparent performance of surfaces became increasingly optimistic as rib angle increases. In the tests performed the multi-start surfaces showed an increase in performance (on an $\mathrm{St}/f^{1/2}$ basis) of up to 5% compared with the transverse-ribbed surfaces. This occurred with a rib angle between 30 and 40° and was achieved by maintaining Stanton number and reducing friction factor. (UK)

3269 DETERMINING THE OPTIMUM VALUES OF CERTAIN CHARACTERISTICS OF THE ELEMENTS OF RADIOGRAPHIC INSPECTION EQUIPMENT. Skachek, M. A.; Dement'ev, B. A.; Korshunov, A. S. (Moscow Power Inst.). Therm. Eng. (USSR) (Engl. Transl.); 21: No. 1, 106-112(Jan 1974).

Translated from Teploenergetika; 21: No. 1, 75-79(Jan 1974).

In the x-ray method for the determination of the steam content in a two-phase flow moving in a channel of large diameter, use is normally made of the procedure involving a narrow beam of radiation. This procedure makes it possible to find the average local steam contents $\phi^{av}_{l(x)}$ with respect to individual chords of the cross section and to construct a diagram of distribution of the light phase over the channel cross section, and by the averaging of this diagram to find the average true steam content ϕ^{av}. To find $\phi^{av}_{l(x)}$ the channel is inspected by radiography through individual chords both in the process of calibration and in the course of experiments. This is a long and laborious process which does not guarantee the investigation against errors caused by inaccuracies of repeated calibration of the source and the detector of radiation to the chords being investigated and by errors in determination of the length of these chords. Another method is preferable. It lies in organizing continuous recording of the distributions of the intensities of radiation with synchronous motion of the source and the detector within the boundaries of the cross section being inspected by radiography. The paper deals with the problems of selection of the rate of change of position of the source and the detector, with the speed of response of the detection circuit, and with elements of the procedure of processing the records of the distributions of the intensities of radiation. (auth)

3270 BOUNDARIES OF REGIMES WITH "WORSENED" HEAT TRANSFER FOR SUPERCRITICAL PRESSURE OF COOLANT. Petukhov, B.S.; Polyakov, A.F. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 12: No. 1, 197-200 (Sept 1974).

We present a more complete generalization of experimental data on the onset of the worsening of heat exchange than is usually reported by allowing for the mean—mass enthalpy of the liquid. The flows of water and of carbon dioxide are investigated. (AIP)

3271 EFFECTS OF BOILING CONDITIONS ON THE PRIMARY SUPERHEATING OF ALKALI METALS. Leonov, A.I.; Prisnyakov, V.F. (Dnepropetrovsk University). High Temp. 12: No. 1, 117-120 (Sept 1974).

Results are given on the primary superheating of sodium, potassium, cesium, and sodium—potassium eutectic alloy in the state of periodic boiling at a wide range of saturation temperatures: it is found that a pressure difference of 0.0105 P_{cr} corresponds to primary superheating for $P_s \geq 1$ bar. It is found that there is no effect of the heating rate up to 110 deg/sec on the superheating, and an empirical relationship is presented between the superheating and the surface tension, which defines the superheating for binary solutions. It is found that traces of impurity gases, especially hydrogen, have the predominant effect on the superheating. (auth)

3272 TWO-DIMENSIONAL ANALYSIS OF LAMINAR FLUID FLOW IN ROD BUNDLES OF ARBITRARY ARRANGEMENT. Mottaghian, R.; Wolf, L. (Technische Univ., Berlin). Int. J. Heat Mass Transfer; 17: No. 10, 1121-1128(Oct 1974).

An outline is presented of an analytical method for calculating fully developed, longitudinal laminar flow in multiple connected regions as for instance in finite tube bundles. This method overcomes the limitation of previous investigations and extends the analysis to problems of more than one rod ring. Results are given in the form of velocity fields and the product ft × Re in dependence on pitch-to-diameter ratio, tube wall spacing, radial displacement of a rod ring, and the angle of the characteristic symmetry segment. (auth)

3273 SEMI-EMPIRICAL METHOD OF DETERMINING THE HEAT-TRANSFER COEFFICIENT FOR SUBCOOLED, SATURATED BOILING IN A CHANNEL. Mikielewicz, J. (Polska Akademia Nauk, Gdansk). Int. J. Heat Mass Transfer; 17: No. 10, 1129-1134(Oct 1974).

On the assumption that heat transfer during flow boiling is characterized by the resultant dissipation of the energy of convective flow of a two-phase mixture and of vapour bubble generation, a relation has been derived defining the heat-transfer coefficient for subcooled and saturated boiling in a channel. The relation obtained has been compared with the results of experiments of the present and other authors. (auth)

3274 TURBULENT HEAT TRANSFER IN A CIRCULAR TUBE WITH CIRCUMFERENTIALLY VARYING THERMAL BOUNDARY CONDITIONS. Gartner, D.; Johannsen, K.; Ramm, H. (Technische Univ., Berlin). Int. J. Heat Mass Transfer; 17: No. 9, 1003-1018(Sep 1974).

An analysis has been carried out to determine the heat-transfer characteristics for turbulent flow in a circular tube with circumferentially varying boundary conditions of the first and second kind. Fully developed flow and heat transfer is considered. Contrary to prior investigations of this problem, anisotropy of turbulent energy transport has been taken into account employing theoretical results for eddy diffusivity in the various directions from an analysis of Ramm and Johannsen which are shown to be in satisfactory agreement with recent experimental data. Results for heat transfer at both constant and varying conditions are presented over a wide range of Reynolds number ($10^4 \leq \mathrm{Re} \leq 10^6$) and Prandtl number ($0 \leq \mathrm{Pr} \leq 100$) and compared to empirical data. (auth)

3275 BOILING HEAT TRANSFER WITH LIQUID METALS. Borishanskii, V. M. (Polzunov Boiler and Turbine Inst., Moscow). Heat Transfer—Sov. Res.; 6: No. 3, 25-36(1974).

This study of boiling heat transfer with liquid metals is based on the theoretical and experimental results of a number of investigators. On their basis it is established that there exist four regions in a steam-generating tube differing markedly by the manner in which heat transfer occurs in them. These are the liquid superheat region, high heat-transfer rate region, deteriorating heat transfer (crisis) region and transition region. The different modes of heat transfer in these regions are described and design equations for each of them are presented. The results of this study also allow one to calculate the boundaries of these regions for the kind of tubes under study. (auth)

Materials Testing

Refer also to abstracts 3269, 3481, and 5536.

3276 (RFP-2059(Rev.)) ACOUSTIC EMISSION: A BIBLIOGRAPHY FOR 1970-1971-1972. Drouillard, T. F. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 15 Mar 1974. Contract AT(29-1)-1106. 128p. Dep. NTIS $9.50.

The bibliography includes almost all references in the literature on acoustic emission published during the three-year period, 1970 through 1972. Included in the 412 references are several for each of the associated technologies including signature analysis, boiling detection, cavitation, leak detection, seismology, and rock mechanics. Information was obtained from eight abstracting and indexing services in compiling the bibliography. The bibliography is arranged alphabetically by author and is cross-referenced with a list of approximately 400 authors. Also included is a subject index. Technical articles listed were published in some 90 different journals and in 8 different languages. (auth)

3277 (SAND–74–0198) CODED SOURCE RADIOGRAPHY. Hansche, B. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 10p. Dep. NTIS $4.00.

Coded aperture radiography is applicable only when the object itself is radioactive, or appears to be. A variation of this technique, called coded source radiography is much more applicable to typical NDT situations. Results of an investigation begun to determine if a practical use can be made of this technique are reported. Since neutron radiography suffers most from finite source size, and in the case of a chemical source, long exposure time, coded source neutron radiography was attempted first. (auth)

3278 (UCRL–51641) RADIATION GAGE IMAGING FOR NONDESTRUCTIVE TESTING APPLICATIONS. Sweeney, D. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Sep 1974. Contract W-7405-eng-48. 20p. Dep. NTIS $4.00.

A radiation gage is used to reconstruct cross-sectional images of the linear absorptivity distribution of complex objects for nondestructive testing applications. The objects must be scanned in many different directions, the amount of data needed depending on the resolution required in the reconstructed image. For typical objects scanned in nondestructive testing, attainable resolution is limited by the finite size of the detector aperture. Two Fourier-transform reconstruction techniques are described in detail. One of the techniques, direct inversion, is used to reduce data from a scanning radiation gage. The resolution of the resulting reconstructed images approached the resolution expected. (auth)

3279 NOMOGRAPHS FOR INDIRECT RADIOGRAPHY WITH THERMAL NEUTRONS. Schuelken, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Reaktorbetrieb und Technik). Kerntechnik; 16: No. 8/9, 365-371(Sep 1974). (In German, English).

11 figs.; 2 tabs.; 7 refs.

This paper presents a set of nomographs for practical use in neutron radiography. They are valid for dysprosium converters in conjunction with Structurix D2 and D7 and Osray DW films. They make it possible to take into account the following exposure parameters before proceeding with irradiation: converter thickness; neutron flux density; irradiation, decay, and exposure times; film sensitivity; neutron absorption in the object; and temperature of the developer bath. Nomographs are also given for the determination of the shortest image transfer time and of the sufficient converter thickness. (auth)

Nuclear Explosions

Refer also to abstracts 3409 and 3705.

3280 (AD-780091) SEMIANNUAL TECHNICAL REPORT, NORSAR PHASE 3, 1 JULY–31 DECEMBER 1973. Bungum, H. (Norges Teknisk Naturvitenskapelige Forskningsraad, Kjeller. NORSAR). 11 Jan 1974. Contract F44620-74-C-0001. 78p. (AFOSR-TR-74-0794). NTIS $4.00.

Research on short period seismic data, and some work using long period data are presented. The physical operation of the array is characterized by stability. (auth)

3281 (AD-780126) MULTIPLE SEISMIC EVENTS. Semiannual Technical Report No. 1. Willis, D. E.; Taylor, R. W. (Wisconsin Univ., Milwaukee (USA). Dept. of Geological Sciences). 15 Apr 1974. 33p. (AFOSR-TR-74-0864). NTIS $3.25.

Visual records from all available sources for eight nuclear shots of a multiple nature have been obtained and converted to digital form. Identification logic employing cepstrum analysis has been established and the application of this logic to real data is presently under investigation. Preliminary results with cepstrum analysis appear encouraging. Identification logic including the use of P-wave radiation patterns and/or cross correlation with signals of known origin are being considered. Preliminary results indicate that for distance ranges of 100 to 1000 km the P-wave radiation pattern may provide a viable means of identification. M_L and M_B magnitude relationships were developed for shots and earthquakes. Triggering of microearthquakes by tidal forces were also investigated. (auth)

3282 (AD-780192) FIREBALL ENTRAINMENT STUDY. Final Report, 18 Aug 1971–30 Sep 1973. Mantrom, D. D.; Haigh, W. W. (TRW Systems Group, Redondo Beach, Calif. (USA)). 30 Sep 1973. Contract DNA-001-72-C-0019. 111p. (DNA-3248F). NTIS $4.50.

An experimental program to study the development and entrainment processes of fireballs is described. The high pressure test facility and diagnostic equipment developed for this subscale laboratory study are discussed. Data acquisition, interpretation, and reduction techniques are outlined. Turbulent and laminar mean size/rise data and particle tracking photographs are compared and results reflect marked differences between these two flow regimes. Properly scaled turbulent dimensional data compare favorably with those of a low yield, low altitude nuclear event. (auth)

3283 (AD-780557) DEVELOPMENT AND EVALUATION OF MEASUREMENT SYSTEMS FOR BLAST-INDUCED MOTIONS IN BURIED STRUCTURES. Final Report, January–December 1972. Pickett, S. F. (New Mexico Univ., Albuquerque (USA). Eric H. Wang Civil Engineering Research Facility). Apr 1974. Contract F29601-72-C-0024. 124p. (AFWE-TR-73-230). NTIS $4.50.

Four types of transducers for measuring blast-induced motions in buried structures were developed and/or evaluated. Potentiometric linear displacement transducers were evaluated based on vendor-supplied data. Application techniques, load error analysis and vendor-suggested improvements were also studied. A gage for measuring relative structure/media interface (SHEAR) displacement was designed, developed, and tested in the CERF 2- X 40-ft shock tube. This gage performed well over the low displacement range for which it was designed. A seismometer for simultaneously measuring absolute structural displacement and velocity was also designed, built, and tested. This transducer also performed well. The suitability of WES Air Force modified (WAM) stress gages and Simmons concrete stress gages for measuring dynamic structure/media interface normal stress was tested in the CERF 2- X 4-ft shock tube. During this test program unexpected results were obtained because of reverberations in the test configuration. Although the results were useful, the data were not adequate for a complete evaluation of these gages. (auth)

3284 (AD-780588) EFFECTS OF NUCLEAR SCATTERING AND ENERGY LOSS ON SMALL SIGNAL HIGH-ALTITUDE ELECTROMAGNETIC PULSE CALCULATIONS. Final Report, March–December 1973. Wittwer, L. A.; Brau, J. E.; Canavan, G. H. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Jun 1974. 25p. (AFWL-TR-74-46). NTIS $3.00.

The effects of nuclear scattering and ionization energy loss on the electromagnetic fields from high-altitude bursts were examined using Monte Carlo techniques to calculate electron trajectories. Maxwell's equations and the Lienard-Wiechert potentials are both used to evaluate the fields. The obliquity model is demonstrated to be an adequate treatment of such effects in electromagnetic pulse calculations. (auth)

3285 (AD-781051) SENSITIVITY OF SELF-CONSISTENT HIGH-ALTITUDE ELECTROMAGNETIC PULSE CALCULATIONS TO PREIONIZATION AND IMPROVED SOURCE AND IONIZATION MODELS. Final Report, March–December 1973. Canavan, G. H.; Brau, J. E.; Wittwer, L. A. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Jun 1974. 41p. (AFWL-TR-74-48). NTIS $3.25.

The Air Force Weapons Laboratory CHEMP code for self-consistent calculations of high-altitude electromagnetic pulses was used to assess the energetic consequences of self-consistency, with particular attention to the alteration of the radiated electromagnetic pulse. Parametric studies indicate the sensitivity of the radiated fields to gamma spectrum, angular distribution of Compton electrons, scattering, cascading, and the reduction of radiated fields by small amounts of precursor ionization in the source region. (auth)

3286 (AD-781126) SEISMIC DECOUPLING EXPERIMENTS. Final Report, 15 December 1970–31 December 1973. Siekmeier, D. A. (Environmental Research Inst. of Michigan, Ann Arbor (USA)). Jun 1974. 8p. (ERIM-197200-7-F). NTIS $3.00.

The seismic events monitored at the Nuclear Test Site in Nevada (NTS) during the contract period and the reports presenting the results of the data analyses for those seismic events are enumerated. Pertinent information about the events and analysis is summarized. The seismic events were Diamond Mine HE, Mine Dust HE, Diamond Mine of the Mighty Mite Series, and the DIDO Queen Event. For purposes of comparison, data from some other events were also used in the analyses. (auth)

3287 (AD-782273) QUARTERLY TECHNICAL SUMMARY REPORT, JANUARY–MARCH 1974. Hartenberger, R. A. (Teledyne Geotech, Alexandria, Va. (USA)). 15 Apr 1974. Contract F08606-74-C-0006. 23p. (SDAC-TR-74-11). NTIS $3.00.

The report summarizes the technical work, support, effort, and data services completed during the quarter. The report is organized into Part A describing operations and maintenance functions

(Tasks 1 through 4) and Part B describing research (Tasks 5 through 8). Part B describes only work represented by completed technical reports. Part C is a summary of the energy conservation measures taken at the SDAC and some early results of those measures. Part D is a review of scientists from foreign nations who visited the SDAC during the first quarter of 1974. (auth)

3288 (AD-782448) ALTERNATIVE DERIVATION OF THE EQUATIONS GOVERNING THE FIREBALL THERMODYNAMICS. Wilson, R. N. (Mission Research Corp., Santa Barbara, Calif. (USA)). Oct 1973. Contract F30602-71-C-0374. 22p. (MRC-N-90; RADC-TR-74-121). NTIS $4.25.

Two alternate derivations of the equations governing the thermodynamics for a simple model of fireball rise and entrainment are presented. These two derivations place emphasis on different sets of the thermodynamic variables. It is important to consider the time rate of change of the specific heat ratio in the equations governing the fireball thermodynamics in the cases where (1) energy storage in internal degrees of freedom is significant, and (2) where energy transfer via dissociation and association processes is significant. (auth)

3289 (AWRE-O-20/74) PEACEFUL USES OF NUCLEAR EXPLOSIVES. Review Paper No. 2. Ground Motion and Seismic Damage from Underground Nuclear Explosions. Atkins, P. J.; Grover, F. H.; Parker, K.; Thirlaway, H. I. S. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Oct 1974. 45p. Dep. NTIS (US Sales Only) $5.25. £1.

A review of the literature on methods of predicting and assessing ground motion and seismic damage from underground nuclear explosions is presented. (TFD)

3290 (CEA-R-4594) THERMOGRAVIMETRIC ANALYSIS OF CARBON DIOXIDE AND WATER IN THE ROCKS BY SELECTIVE ABSORPTION. Balard, F.; Crie, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 – Montrouge (France)). Oct 1974. 16p. (In French). Dep. NTIS (US Sales Only) $4.00.

The water, carbonate, and reducing agent contents of a soil is of utmost importance in the physicochemical evaluation of a contained nuclear shot cavity. After the collapse of the cavity, the consequent chemical evaluation of the chimney gas depends on the thermochemical behavior of the sourrounding rock. The thermogravimetric analysis by selective absorption allows the measurement of the water and carbonate quantities contained in the rock under methodic and careful sampling around the forecast shot point. Useful data are given on the degassing temperatures of steam and carbon dioxide. The explored temperature range goes up to 1200°C. The possibilities of the method are illustrated by some results relating to a basalt and a silty sandstone. (auth)

3291 (FOA-C-20008-T1) HAGFORS OBSERVATORY 1972, ANNUAL REPORT. Dahlman, O.; Israelson, H.; Slunga, R.; Hoernstroem, G.; Waegner, H.; Lindh, B.; Nedgard, I.; Nordgren, L. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Sep 1974. 29p. Dep. NTIS (US Sales Only) $4.50.

This annual report from the Hagfors Observatory, operated by the Research Institute of the Swedish National Defence, summarizes the work at the Observatory in 1972. Available source data from 34 nuclear explosions are presented. Seismological data from 26 of these explosions recorded at Hagfors are presented. Around 4,800 shortperiod signals were recorded at HFS, 285 of these are coming from events located by the Observatory which are not earlier reported. Shortperiod identification data from 24 explosions and 33 shallow earthquakes in western part of North America are presented. The variation of the $m_b(M_s)$ discriminant with depth of focus is illustrated using Eurasian explosions and earthquakes. A model is presented by which explosions giving only detectable P-waves sometimes can be identified using the negative evidence about surface waves. The model shows that the applicability of the $m_b(M_s)$ method could be extended about half a magnitude below the Rayleigh wave detection threshold. Seismic events reported to have occurred in the USSR in 1971 have been studied to assess the operational seismic monitoring problem. The dependence of crustal P-waves on explosion yield and recording distance has been studied for chemical explosions in northern Sweden. (auth)

3292 (JAB-99-55) FOURTH PROGRESS REPORT ON RACKING TESTS OF WALL PANELS. Freeman, S. A. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). Sep 1974. Contract AT(26-1)-99. 108p. Dep. NTIS $5.45.

Results from final phases of the testing program reported in the First, Second, and Third Progress Report(s) on Racking Tests of Wall Panels, (NVO-99-15, JAB-99-35, and JAB-99-54, respectively) are presented, consisting of data from fifteen additional wall panels. Of these, six had been tested at the time of issuance of the preceding report in this series, but the data had not yet been analyzed. One is plaster on metal lath, two are variants of previous wall panels, and three are special plywood panels. The nine remaining panels, gypsum wallboard on metal lath, were tested by the Engineering Department of the University of Nevada, Las Vegas. Innovations to the previous testing procedures include variations in end, top, and bottom panel details, the addition of a magnetic tape-recording system, and a special frequency parameter study. The results are presented by means of load-displacement and energy-displacement curves for each test. An approximation of equivalent viscous damping based on dimensionless energy absorption values is also presented, with a discussion and an example of its application to structural response investigations. Results are compared with earlier test results, and conclusions are made that revise or supplement the conclusions of the three previous reports. This report, an addendum to the previous report, terminates the data collection portion of this wall panel test series. A final report will summarize all data in the four progress reports. (auth)

3293 (JAB-99-104) DYNAMIC RESPONSE CHARACTERISTICS OF TWO 2-STORY TEST STRUCTURES. Czarnecki, R. M.; Reed, J. W. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). Oct 1974. Contract AT(26-1)-99. 41p. Dep. NTIS $4.00.

Vibration tests were conducted on two 2-story test structures at the Atomic Energy Commission's Nevada Test Site in southern Nevada to examine the observed dynamic response characteristics for the buildings, including fundamental mode periods, damping ratios, and mode shapes. This study concludes that the dynamic behavior of the test structures are typical of low-rise buildings. The fundamental period of vibration of the brick house is between 0.072 and 0.081 seconds, and the period of the wood-frame house is between 0.135 and 0.142 seconds. Both structures are relatively highly damped; however, the damping ratios were quite variable. It was observed that the stiffer structure, as compared to the more flexible structure, experienced more foundation participation and less dynamic amplification when exposed to a long-period ground motion. It is concluded that the analysis of free-vibration records, as compared to forced-vibration records, produces better estimates of dynamic response characteristics. (auth)

3294 (JAB-99-109) DYNAMIC RESPONSE CHARACTERISTICS OF THREE 1-STORY BUILDINGS. Reed, J. W. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). Oct 1974. Contract AT(26-1)-99. vp. Dep. NTIS $5.45.

This study reports the dynamic characteristics of three 1-story structures as derived from pull-release tests. The empirically obtained periods, damping ratios, and mode shapes are compared with corresponding properties derived from analytical soil-structure interaction models. Both the experimental and theoretical results verify that significant soil-structure interaction may exist for low-rise residential and commercial buildings. The reasonable agreement between model and test data suggests that the lumped-mass analytical model can be used to extrapolate to more general low-rise building, soil-structure situations. Both the observed and theoretical results indicate that stiffer buildings produce greater relative soil participation. Observed fundamental periods range between 0.09 and 0.28 seconds, while corresponding "best estimate" critical damping ratios range between 0.10 and 0.15. (auth)

3295 (PNE-MHF-2) RIO BLANCO MASSIVE HYDRAULIC FRACTURE. Phase II. Organization. (CER Geonuclear Corp., Las Vegas, Nev. (USA)). 1 Aug 1974. 48p. Dep. NTIS $5.50.

The organizational phase of the Rio Blanco Massive Hydraulic Fracture experiment in which the USAEC, Dept. of Interior, and 13 to 20 industrial companies are participating is described. Information is included on the drilling, fracturing, and evaluation program, safety considerations, logistics, public information, and environmental assessment. (LCL)

3296 (UCID-15994) DYNAMIC LOADS ON GROUTED EMPLACEMENT SYSTEMS. Norris, D. M. Jr.; Staats, J. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1970. 28p. Dep. NTIS $4.50.

An analysis of the dynamic loads on an emplacement pipe string from an underground nuclear explosion is presented. The orientation is to the Rio Blanco natural gas stimulation experiment, however, the conclusions of the study have general application to design of other grouted emplacement systems. Obvious commercial applications include petroleum recovery stimulation, geothermal heat recovery, block cave mining, underground storage, and in-situ leaching. The analysis shows that: (1) the stress wave in the casings does not outrun the stress wave in the formation rock, (2) stresses in the casing-grout emplacement composite are dependent only upon the stress state in the adjacent formation, and (3) these emplacement system stresses may be accurately predicted from a curve of formation peak radial dynamic overpressure versus range. The work presents a basis for rational engineering decisions on structural design for such important problems as adequate containment for nuclear debris, easy and rapid reentry to the chimney zone for commercial applications, zone isolation for aquifer intrusion, and enhanced shock isolation for sequential detonations and post detonation chimney communication. The information is presented in five sections: (1) a description of the finite element method used in this analysis, (2) the physical system model, (3) results of the dynamic analysis, (4) static nested cylinder theory for calculation of dynamic loads, and (5) correlation with the Salmon event behavior. (auth)

3297 (UCID-16152) CRITIQUE OF THE REPORT ON SEISMIC EFFECTS PREDICTION, PROJECT RIO BLANCO, PICEANCE BASIN, COLORADO, BY DAMES AND MOORE. Germain, L. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Nov 1972. Contract W-7405-eng-48. 55p. Dep. NTIS $5.75.

A study and critique of the Dames and Moore report is made with special attention given to ground motion, earthquakes and sequential firing; it is concluded that the report does not give a balanced presentation of the effects considered. A copy of the Dames and Moore report is included as an appendix. (auth)

3298 WHAT THE INDIAN NUCLEAR EXPLOSION WILL MEAN FOR CANADA'S NUCLEAR POLICY. Carruthers, J. Sci. Forum; 7: No. 4, 17-19(Aug 1974).

The impact of the Indian underground nuclear explosion on Canada's policy with regard to sales of nuclear power reactors is discussed from an independent viewpoint. It is probable that Canada will require bilateral agreements as well as IAEA safeguards from nations that have not signed the Non-Proliferation Treaty (NPT). The NPT is specific in prohibiting the proliferation of all nuclear explosive devices, even though they may be intended for peaceful purposes. Although the author is somewhat pessimistic in his conclusions, he implies that the problems apply equally to other countries selling nuclear technology, not merely to Canada. (CA)

Protective Structures and Equipment

Refer also to abstract 4050.

3299 (ORNL-4941) EXPEDIENT SHELTER HANDBOOK. Final Report. Cristy, G. A.; Kearny, C. H. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. vp. Dep. NTIS $10.60.

This manual is designed to assist local civil defense organizations prepare plans consistent with the changing strategic conditions of the seventies. The Defense Civil Preparedness Agency is moving into a new program of "all-hazards, all-contingencies" planning which will involve developing a crisis-oriented evacuation capability. This capability will increase the survivability of the population in the event of a nuclear attack and will be a counter against certain "nuclear blackmail" threats. Planning for the development of shelter capabilities for either an "in-place" or evacuated posture will require an ability to rapidly build large numbers of new expedient shelters in addition to upgrading existing fallout shelters. (Expedient shelters are shelters which can be built under crisis conditions within 48 hours using only locally available materials, equipment, and labor.) Detailed step-by-step instructions and pictorial design drawings of fifteen expedient shelters are included in the Appendices. The instructions and drawings for any of these shelters can be preprinted by local C. D. organizations for rapid dissemination in a crisis. The shelter designs are simple enough that they can be built by ordinary Americans, even ones who have had no previous building experience and who have no guidance other than these drawings and instructions. Many of the designs have been proof-tested (i.e., built under simulated crisis conditions by unskilled urban or rural people with no prior preparation other than reading these instructions for building one of these shelters). Designs and instructions for building Kearny Air Pumps (KAP's) and an expedient, quick-closing blast door are also included in the Appendices. It is recommended that all of these shelters, especially the designs that have not yet been built by average citizens, be proof-tested under simulated crisis conditions by ordinary civilians and that the experiences so gained be used to refine and improve the designs and instructions. (auth)

3300 (ORNL-TM-4719) ORNL RESPIRATOR PROGRAM: A PROGRAMMATIC DESCRIPTION. Bolton, N. E. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 95p. Dep. NTIS $7.75.

The ORNL Respirator Program is designed to provide employees with devices which afford maximum protection with minimum discomfort. Teamwork is essential since a comprehensive program involves the Health Division, the Industrial Hygiene Department, Applied Health Physics, the Operations Division, the Inspection Engineering Department, and the Fire Department. The purpose of this manual is to describe in detail the ORNL Respirator Program. Included are discussions of the following elements: quality assurance, selection, man-testing, maintenance and issue, certified breathing air for self-contained breathing apparatus, inspection, program surveillance, available devices, and standard operating procedures. As the program develops and improvements are made, periodic revisions may be necessary. The Industrial Hygiene Department will perform this task on an "as required" basis. (auth)

Safety Engineering

Refer also to abstracts 3001 and 3059.

ENVIRONMENTAL AND EARTH SCIENCES

3301 UMWELTSCHUTZ BEI NUKLEARER UND KONVENTIONELLER ENERGIEGEWINNUNG. (Environmental Protection in Nuclear and Conventional Energy Production. 12th annual meeting of the Association of German Radiation Protection Doctors, Munich, Germany, October 8-9, 1971). Braun, H.; Heuck, F.; Ladner, H. A.; Messerschmidt, O.; Niklas, K.; Rausch, L. (eds.). Strahlenschutz in Forschung und Praxis, Band XII. Stuttgart; Georg Thieme Verlag (1973). 326p. (CONF-711086-).

The papers presented at the conference and the panel discussions on the primary themes are compiled. The conference was divided into two sections: the first concerned environmental protection in nuclear and conventional energy production and the second reported the results of radiation and environmental research. Separate abstracts were prepared for 17 papers. (JSR)

For abstracts of individual papers see: 2754, 3060, 3313, 3314, 3330, 3331, 3398, 3508, 3600, 3689, 3713, 5168, 5196, 5250, and 5280–5282.

Minerals and Ores

Refer also to abstracts 2915, 2916, and 3986.

3302 (AEC-tr-7593) PECULIARITIES OF URANIUM DISTRIBUTION IN HIGHLY METAMORPHIC AND ULTRAMETAMORPHIC ROCKS. Zhukova, A. M.; Venidiktov, V. M.; Zhukov, G. V. Translated from Geol. Zh. (Russ. Ed.); 34: No. 1, 118-122(1974). 118-122p. Dep. NTIS $4.00.

The character of uranium distribution in Precambrian formations of the Ukranian shield metamorphased in granulite and amphibolite facies is examined. (auth)

3303 (AEC-tr-7594) AVERAGE URANIUM CONTENTS OF PRECAMBRIAN FORMATIONS IN THE UKRAINIAN SHIELD. Zhukova, A. M. Translated from Geokhimiya; 8: 1245-1253(1973). 10p. Dep. NTIS $4.00.

The uranium contents of the different parts of the Ukrainian Shield are tabulated, and the various formations are described in tabular form. The uranium content is low in 40 to 45% of the Shield; in 12% of the area, the content is about the same as in the general earth's crust; and in about half the shield the content is 1.5 to 4 times that in the general crust with the 4-fold value in 2 to 3% of the total Shield. (MG)

3304 REPORTED URANITE, URANOCHRE, AND URANOCITE OF THE SEYMOUR IRON MINE, MADOC TOWNSHIP, ONTARIO. Ansell, H. G.; Steacy, H. R. (Geological Survey of Canada, Ottawa). Can. Mineral.; 12: No. 3, 232-233(Dec 1973).

Secondary uranium minerals reported at the old Seymour iron mine have been shown to be ferrimolybdite, a nonuraniferous mineral. Eight specimens from neighboring iron mines and one from Haliburton county were not radioactive. (CA)

3305 GEOGRAPHICAL COINCIDENCE OF HIGH HEAT FLOW, HIGH-SEISMICITY, AND UPWELLING, WITH HYDROCARBON DEPOSITS, PHOSPHORITES, EVAPORITES, AND URANIUM ORES. Libby, L. M.; Libby, W. F. (Univ. of California, Los Angeles). Proc. Nat. Acad. Sci. U. S. A.; 71: No. 10, 3931-3935(Oct 1974).

Oil deposits occur in deep sediments, and appear to be organic matter that has been transformed through the action of geothermal heat and pressure. Deep sediments, rich in biological remains, are created by ocean upwelling, caused in part by high geothermal heat flow through the sea bottom. Such regions correlate with enhanced seismic activity. Correlations of seismicity, high heat flux, petroleum, uranium, phosphates, and salts, deposited from abundant plant life are sought. These may be useful in discovering more petroleum and coal. It is estimated that the known world reserves of petroleum and coal are about 10^{-4} of the total of buried biogenic carbon. (auth)

3306 UNITED STATES MINERAL RESOURCES. Brobst, D. A.; Pratt, W. P. (eds.). Geological Survey Professional Paper 820. Washington, DC; Geological Survey (1973). 729p. GPO $9.15.

Mineral resources of the U. S. are discussed, with emphasis on geology and summary information on uses, technology, and economics. The following chapter titles are included: Introduction, Mineral resource estimates and public policy, Crustal abundance of elements, and mineral reserves and resources, Abrasives, Aluminum and bauxite, Antimony, Arsenic, Asbestos, Barite, Beryllium, Bismuth, Bitumen-bearing rocks, Cadmium, Chromium, Clays, Coal, Cobalt, Construction stone, Copper, Diatomite, Evaporites and brines, Feldspar, Fluorine, Gallium, germanium, and indium, Gem stones, Geothermal resources, Gold, Graphite, Helium, Iron, Kyanite and related minerals, Lead, Lightweight aggregates, Limestone and dolomite, Lithium, cesium, and rubidium—the rare alkali metals, Magnesian refractories, Manganese, Mercury, Mica, Molybdenum, Nickel, Niobium, Nuclear Fuels, Oil and gas, Oil shale, Peat, Phosphate deposits, Pigments and fillers, Platinum-group metals, Rare-earth elements, Rhenium, Sand and gravel, Scandium, Selenium, Silica sand, Silver, Sulfur, Talc, Tellurium, Thallium, Tin, Titanium, Tungsten, Vanadium, Zeolites in sedimentary rocks, Zinc, and Zirconium and hafnium. Bibliographies are included at the end of each chapter. (JGB)

3307 URANIUM ISOTOPES IN METEORIC WATERS OF CENTRAL ASIA. Zverev, V. L.; Spiridonov, A. I. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). Geokhimiya; No. 8, 1256-1259(Aug 1974). (In Russian).

Two sources of uranium in atmospheric precipitates were investigated: continental aerosols of the arid zone and sea salt aerosols of the humid zone. The effect of terriginic material on the uranium isotope balance in surface waters was shown to be due to the specific climate of Central Asia. (tr-auth)

3308 POSSIBILITY THAT CERTAIN ISOTOPIC ANOMALIES ON THE EARTH MAY BE DUE TO AN ANNIHILATION EXPLOSION. Vlasov, N. A. Sov. At. Energy (Engl. Transl.); 34: No. 5, 483-484(May 1973).

Translated from At. Energ. (USSR); 34: No. 5, 395-396(May 1973).

The hypothesis is presented that a meteorite composed of antimatter could have fallen to the earth $1.7 \cdot 10^9$ years ago, and that the annihilation explosion of an antimeteorite could have created the neutron source which is responsible for the interesting anomalies in the isotopic content of ^{235}U and several rare earth elements in the ores in one of the uranium deposits in Gabon. (LCL)

3309 LEVELS OF URANIUM AND THORIUM ACCUMULATION IN HYDROTHERMAL MINERALS. Plyushchev, E. V.; Ryabova, L. A. (All-Union Scientific-Research Geological Inst., Leningrad). Geokhimiya; No. 8, 1192-1203(Aug 1974). (In Russian).

Data on uranium and thorium content in hydrothermal minerals of various types of deposits are given. On the basis of these data some peculiarities of uranium and thorium behavior in processes of the formation of rare-metal greisens, molybdenum-containing secondary quartzites, molybdenum- and gold-containing berezites, argillizites and some other metasomatites were marked. (auth)

3310 ENCYCLOPEDIA OF MINERALS. Roberts, W. L.; Rapp, G. R. Jr.; Weber, J. New York; Van Nostrand Reinhold Company (1974). 712p. $69.50.

This encyclopedia of minerals provides a glossary of mineralogical terms followed by a compendium of chemical, physical, crystallographic, x-ray, optical, and geographic data on over 2200 alphabetically arranged species of all known and authenticated minerals. The following information is given for each mineral: crystal system; class; space group; lattice constants; optical constants; 3 strongest diffraction lines; hardness; density; cleavage; habit; color-luster; mode of occurrence; and best reference in English. Nearly 1000 full color photomicrographs are included. (LCL)

Radioactive Effluents

Refer also to abstracts 3317, 3447, 3448, 4021, and 5427.

3311 (BNWL-SA-5012) USE OF DEPOSITION COLLECTOR PARTICLE-SIZE DATA IN THE INVESTIGATION OF ENVIRONMENTAL EXCHANGE MECHANISMS OF PARTICULATE POLLUTANTS. Waite, D. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 4 Sep 1974. 15p. (CONF-740921-18). Dep. NTIS $4.00.

From atmosphere–surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

The construction of environmental contamination pathway models has demonstrated the acute need for re-entrainment data in the assessment of population doses. Experience is showing that the deposition collector particle-size technique has the capability to provide information on both concentration and particle-size distributions in the environment. The Pu deposition and re-entrainment question is only one of the many areas in which this technique is applicable. (auth)

3312 (LA-5744) STORM RUNOFF AND TRANSPORT OF RADIONUCLIDES IN DP CANYON, LOS ALAMOS COUNTY, NEW MEXICO. Purtymun, W. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1974. Contract W-7405-eng-36. 9p. Dep. NTIS $4.00.

Effluents from the waste treatment plant at Los Alamos Scientific Laboratory's Technical Area 21 are released into DP Canyon. The radionuclides remaining in the effluents are bound to stream-channel sediments which are later carried out of the canyon by storm runoff. A study was made to determine the runoff volume, the suspended-sediment load, and the amount of radioactivity carried out of DP Canyon by storm runoff. During the summer of 1967, precipitation resulted in 23 runoff events that carried ≈88,000 kg of suspended sediments out of the canyon in ≈36,800 m^3 of water. Less than 74 μCi of gross alpha emitter and ≈40,100 μCi of gross beta were carried out of the canyon in solution. The suspended sediments carried out ≈70 μCi of gross alpha emitters and ≈11,300 μCi of gross beta emitters. About 31,000 μCi of ^{90}Sr left the canyon in solution, as did traces of ^{238}Pu, ^{239}Pu, and ^{241}Am. (auth)

3313 ACTIVITY RELEASE FROM NUCLEAR POWER PLANTS. Quell, P. (Kernforschungsanlage, Juelich, Ger.). pp 158-170 of Umweltschutz bei nuklearer und konventioneller energiegewinnung. Braun, H. (ed.). Stuttgart; Geog Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

The risks associated with various professions and occupations, measured in fatalities per 100,000 per year are tabulated and briefly discussed. The origin of activities in nuclear power plants, the activities produced and their containment, the possible radiation effect, the permissible doses, and the actual release from various types of reactors are discussed. The effect of the activities released on the environment is considered. (JSR)

3314 PODIUM DISCUSSION: ENVIRONMENTAL PROTECTION IN NUCLEAR AND CONVENTIONAL ENERGY PRODUCTION. Rausch, L. (ed.). (Univ., Giessen). pp 187-221 of Umweltschutz bei nuklearer und konventioneller energiegewinnung. Braun, H. (ed.). Stuttgart; Geog Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

The panel discussion and remarks from the audience on energy sources and consumption up to the year 2000, development of power reactors up to the year 2000, environmental burden from conventional power plants, environmental burden from coolant water and the economy of conventional and nuclear power plants, and the environmental burden from nuclear power plants are compiled. (JSR)

3315 DISPOSAL OF RADIOACTIVE WASTE FROM A NUCLEAR POWER PROGRAMME. Dunster, H. J. (National Radiological Protection Board, Harwell, Eng.). Nucl. Eng. Int.; 19: No. 220, 744-746(Sep 1974).

Worries are still expressed about the adequacy of radiation standards, the effects of the normal radioactive effluents from nuclear power stations, the disposal of the fission products resulting from nuclear generation, and the ultimate disposal of the very long-lived transuranic isotopes, particularly those of plutonium. A review is presented which summarizes the present position about radiation standards, the effluent from power stations, and the disposal of long-lived radioactive wastes. (auth)

3316 MAXIMUM PERMISSIBLE DISCHARGE OF RADIOACTIVE MATTER INTO THE ATMOSPHERE FOR EXTERNAL IRRADIATION. Ruzhentsova, I. N.; Teverovskii, E. N. At. Energ. (USSR); 37: No. 3, 239-243(Sep 1974). (In Russian).

Methods of calculating average annual permissible concentrations of radioactive matter in the atmosphere, the discharge of which leads to external irradiation, are presented. On the basis of these methods, values of maximal permissible discharge are estimated. (4 tables, 12 references). (auth)

Radioactivity Monitoring and Transport

Refer also to abstracts 2844, 3413, and 3482.

3317 (AED-CONF-74-157-022) AIMS OF THE MEASURING TECHNIQUES IN THE MONITORING OF RADIOACTIVE EFFLUENTS. Mehl, J. (Bundesministerium des Innern, Bonn (F.R. Germany)). 1974. 8p. (In German). INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, F.R. Germany (14 May 1974.

17 refs.

The main aims of effluent control are the testing of the adequacy of the system parts controlling the discharge, the estimation of the potential radiation exposure to the population by the discharge of radioactive materials and the proof of the observation of regulations and standards to be complied with, and other operation limiting values. (GE)

3318 (AERE-PR/EMS-1) ENVIRONMENTAL AND MEDICAL SCIENCES DIVISION PROGRESS REPORT, JANUARY–DECEMBER 1973. Johnston, J. E.; Suttar, T. V. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jul 1974. 82p. Dep. NTIS (US Sales Only) $7.25. UK p1-50.

Brief summaries are presented of research programs at Harwell during 1973. A list is included of 54 scientific papers published or submitted for publication during the year. Research studies included the assessment of the health hazards of inhaled particles using radioisotope-labeled cigarette smoke, asbestos fibers, and Pb aerosols; the performance testing of whole-body counters for the detection of low-level radioactivity in human subjects; methods for radiation dosimetry in the event of nuclear accidents; fallout monitoring; the study of atmospheric particles, including the determination of the chemical composition of particulate materials; the investigation of various sample treatment procedures for the determination of trace elements in biological materials; and the development of computerized data acquisition and processing systems. (CH)

3319 (BNWL-1811(Add.)) ENVIRONMENTAL SURVEILLANCE AT HANFORD FOR CY-1973 DATA. Nees, W. L.; Corley, J. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1974. Contract AT(45-1)-1830. 132p. Dep. NTIS $5.45.

This supplemental report is a compilation of results obtained from both analyses of environmental samples and from radiological measurements made in the Hanford environs during 1973. The significance of these data is discussed in the parent report, BNWL-1811. (auth)

3320 (HASL-287) SECOND WORKSHOP ON THE NATURAL RADIATION ENVIRONMENT (FEBRUARY 1974). Lowder, W. M. (ed.). (USAEC Health and Safety Lab., New York). Sep 1974. 168p. (CONF-740212-). Dep. NTIS $7.60.

Separate abstracts were prepared for eight papers included. Abstracts of three papers appeared in NSA previously as numbers 29: 24291, 30: 3362, and 30: 9536. (CH)

For abstracts of individual papers see: 2924, 3321, 3322, 3369–3371, 3379, and 3455.

3321 (HASL-287, pp 59-69) REAL AND APPARENT VARIATIONS IN THE TERRESTRIAL GAMMA-RAY FLUX. Adams, J. A. S. (Rice Univ., Houston, TX); Gesell, T. F. Sep 1974.

From 2nd environmental radiation workshop; New York, New York, USA (20 Feb 1974).

In second workshop on the natural radiation environment (February 1974).

The measurement of small changes in environmental radiation levels caused by nuclear facilities is complicated by the temporal and spatial changes in natural radiation levels. These changes may be entirely natural in origin or may be affected by man's activities. Low altitude (~50 feet) γ-spectrometric surveys from helicopters in Canada, Kansas, Oklahoma, Puerto Rico, Texas, and Wyoming have provided a preliminary basis for estimating how much the terrestrial γ-ray flux might be expected to vary from one football field sized area of ground to the next. These aerial survey data, together with detailed ground studies of such geologic units as the Conway Granite of New Hampshire, the Gueydan of Texas, and the Sweetwater Granite and White River Tuff of Wyoming have led to the concept of the geochemical cell. The geochemical cell describes the shape and dimensions of a volume of rock or soil that is homogeneous in respect to thorium, uranium, and potassium content. The modern Texas beach has geochemical cells a few tens to hundreds of feet wide, miles long, and few inches to a few tens of feet thick. A hurricane storm can completely eliminate a Texas beach geochemical cell. The thorium, uranium, and potassium contents of the country rock, as modified and obscured by weathering and depositional processes, greatly affect the spectral characteristics of the terrestrial γ-ray flux and the variability of that flux. The measured dose equivalent rate around three Texas nuclear power plant sites ranged from less than 1 μrem/hour to over 8 μrem/hour in each case. In addition to infrequent events such as hurricanes and major storms are diurnal and other time variations in the terrestrial gamma-ray flux. The magnitude and frequency of time variations of environmental radiation are not adequately understood nor appreciated. The attenuation of the γ-ray from the ground by thick snow cover and increased levels after a heavy rain are cited as examples. In addition to these variations in the natural radiation environment, which are indeed natural, variations may be induced by man's technological activities. A technologically altered natural radiation environment (TANRE) is defined for these purposes as the change in environmental radiation exposure rates due to truly natural sources of radiation brought about by technological activities not expressly designed to produce radiation. A number of examples are discussed. (CH)

3322 (HASL-287, pp 70-96) RESEARCH PROGRESS IN AIRBORNE SURVEYS OF TERRESTRIAL GAMMA RADIATION. Burson, Z. G. (comp.). (EG and G, Inc., Las Vegas, NV). Sep 1974.

From 2nd environmental radiation workshop; New York, New York, USA (20 Feb 1974).

In second workshop on the natural radiation environment (February 1974).

Research progress in the last few years in airborne surveys of terrestrial radiation has been in measuring, recording, and interpreting the gamma ray signals in NaI(Tl) crystals. Non-terrestrial background contributions continue to be a major source of error in characterizing γ radiation on or in the soil. Research has focused on defining the individual contributions from cosmic rays, aircraft components, and airborne radioactivity and in developing methods to account for these contributions. Better methods are still needed to account for airborne radioactivity. Research directed toward determining the water equivalent of snow cover by airborne measurement of terrestrial γ radiation has shown the method to have good potential for large scale, rapid areal measurements over flat or rolling terrain. Analysis of data from repeat surveys over areas surrounding reactor sites have shown that average differences of 0.5 μR/hr in terrestrial γ radiation levels over large areas can be observed between airborne surveys when the non-terrestrial background contributions are properly accounted for. New data acquisition and recording systems allow a full spectrum to be recorded every three seconds. This results in isotope concentration determinations with spatial resolution of a few hundred feet, as needed. Recent measurements from helicopters over the Enewetak Atoll and the Hanford Facility have shown that a variety of radiation situations can be defined from airborne platforms. Terrestrial exposure rates, concentration of major γ producing isotopes, and total inventories were determined in spatial resolutions of a few hundred feet. The average terrestrial γ dose rates have been determined from aerial survey data for specific areas surrounding each of 20 nuclear reactor power plants. This dose rate information has been combined with population distribution data, to give the average terrestrial dose rate per person (mrad/year per man). Values ranged from a low of 18 mrad/year at Oyster Creek to 113 mrad/year at Fort St. Vrain. For 18 sites in the Northeastern and North-central United States, the mean terrestrial dose rate per capita was 46 mrad/year, while the average dose rate per unit area considered was 43 mrad/year. The sample covered 19,400 square miles and 4.4 million people. (auth)

3323 (LA-5726-PR) CONTAMINATION LIMITS FOR REAL AND PERSONAL PROPERTY. Progress Report, January–June 1974. Healy, J. W.; Smith, W. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1974. Contract W-7405-eng-36. 7p. Dep. NTIS $4.00.

A summary is given of the work performed during this period. Studies included continuation of work on contamination transfer and the FIDLER response and a review of a petition on plutonium limits by the Natural Resources Defense Council. In addition, a summary of comments on the proposed soil standard for plutonium is included. (auth)

3324 (LA-UR-1590) PLUTONIUM-238 RELEASE IN SIMULATED NATURAL ENVIRONMENTS. Patterson, J. H.; Matlack, G. M.; Nelson, G. B. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 18p. (CONF-740921-9). Dep. NTIS $4.00.

From atmosphere–surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

Radioisotope thermoelectric generators (RTG) are designed with a great factor of safety to withstand all aspects of space missions including orbital reentry and earth impact and to provide containment until the fuel material is safely recovered. Several space missions have shown that the present designs are very good from a safety standpoint, but more data about the ^{238}Pu isotopic fuel is continually being sought to improve the safe use of the RTG's. As part of this larger program, LASL is studying the effects of various environmental conditions on fuel by exposing ^{238}PuO$_2$ RTG fuel component samples to simulated weather conditions in environmental test chambers. The samples were placed on the surfaces of soils in deep trays and were subjected to diurnal humidity and temperature cycling to simulate summer and winter conditions in humid temperature climates. A spray system was used to simulate rain, with 32-mm rains occurring once a week. The fragments from an impact test of a sphere of sintered plutonium dioxide, 80% enriched in ^{238}Pu, were used in two experiments. The larger fragments, 224 g of pieces greater than 6 mm in diameter, were placed on humus soil. The finer fraction, 28 g of material with diameters between 0.01 and 6 mm was also placed on humus soil in a separate chamber. The condensate from the chamber dehumidifiers (a measure of airborne particulates), the rain water that percolated through the soil, and core samples of the soil were analyzed for ^{238}Pu. In the large-particle experiment the plutonium release rate to air increased in four months from about 0.04 μCi per month to a constant value of about 4 μCi per month. In contrast, the initial rate of about 0.8 μCi per month for the fine-particle experiment decreased to approximately 0.4 μCi per month. The thermal shock when the cold rain water struck the large pieces, which have surface temperatures above 250°C, caused spallation of very fine particles. The fact that condensates collected after a rain contained more plutonium than other condensates confirmed this explanation. Determination of the plutonium in particulate samples collected from the air in the chamber during a rain sequence on the larger pieces showed a great increase in the average air concentration over the prerain concentration during the first five minutes of rain, in agreement with the spallation mechanism suggested. Within an hour after the end of the rain, the concentration had returned to the prerain value. Size studies of the plutonium oxide particles in soil core samples indicated that there was comminution of the finer material also. (auth)

3325 (LBL-2195(Rev.)) PRE-OPERATIONAL AND OPERATIONAL ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS AROUND POWER REACTORS. Budnitz, R. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1974. Contract W-7405-eng-48. 17p. Dep. NTIS $4.00.

A general overview is given of the requirements for environmental monitoring programs around nuclear power reactors. The emphasis has been on radiological measurements in two types of environmental measurement situations: pre-operational; operational. The goals of the various programs have been outlined, along with the relevant regulations. Discussions of the sampling part of each program have been included, along with some comments on the choice, deployment, and use of instrumentation. Other sources must be consulted for detailed discussions of instruments and analytical techniques. The goal is to give the interested but inexpert reader some insight into the complexities of environmental monitoring programs. The difficulties involved in establishing a viable program should not be thought of as insurmountable: on the contrary, many skilled personnel are easily capable of carrying out these sampling and measuring programs, including the occurrence of unexpected demands from time to time. (auth)

3326 (NP-20224) RADIATION HEALTH AND SAFETY. Annual Report for the Year Ending 31 December 1973. (New South Wales Univ., Kensington (Australia)). [nd]. 17p. Dep. NTIS (US Sales Only) $4.00.

Aspects of the radiation health and safety at the University of New South Wales are reviewed for the year 1973. These include personnel monitoring, radioactive waste disposal, licenses, purchase and transfer of radiation sources, radiation insurance, investigations and reports on school projects, and a summary of radiation accidents during the year. (AT)

3327 (NRL-F-52) ENVIRONMENTAL RADIOACTIVITY ANNUAL REPORT, 1973. (National Radiation Lab., Christchurch (New Zealand)). Jun 1974. 39p. Dep. NTIS (US Sales Only) $5.00.

During 1973 the country-wide average deposition of ^{90}Sr on New Zealand was the lowest since measurements commenced in 1960. A maximum country-wide average level of 3.6 millicuries per square kilometre was deposited in 1964 following the large scale U.S.S.R. and U.S.A. nuclear tests in 1961 and 1962. Annual deposits thereafter decreased to a minimum of 0.8 mCi/km^2 in 1968. Smaller increases reaching a maximum annual deposit of 1.4 mCi/km^2 occurred in the next few years as a result of French nuclear tests in the South Pacific. During 1973, however, the country-wide average deposit decreased to 0.3 mCi/km^2, less than one-tenth the 1964 maximum. It is estimated that at the end of 1973 about 20% of the total ^{90}Sr deposition on New Zealand had come from French tests in the South Pacific. The concentration of ^{90}Sr and ^{137}Cs in milk reflect the changes in fallout deposition. The average levels during 1973 were the lowest since measurements commenced. (auth)

3328 (PNE-RB-51-10) RADIOLOGICAL MONITORING PROGRAM, PERIOD COVERING MAY 1, 1974 THROUGH JULY 29, 1974 FOR CER GEONUCLEAR CORPORATION, PROJECT RIO BLANCO. (Eberline Instrument Corp., Santa Fe, N. Mex. (USA)). [nd]. 16p. Dep. NTIS $4.00.

Beta radioactivity in air particulate samples continued to increase into May 1974 as noted during the previous period, peaking during the first two weeks of May, 1974. This increase is attributable to injection of year old fission products from the upper atmosphere due to spring mixing of the upper and lower atmosphere (see the report for period ending April 30, 1974 for a more complete explanation). The radioactivity is not attributable to Project Rio Blanco. After the second week in May, the air concentration shows a decreasing trend from a peak concentration of 0.54 pCi/m^3 in May to less than 0.1 pCi/m^3 at the end of July. TLD data for this period indicated an average background dose rate of 2.2 mrem/week. There is no evidence of any increase due to Rio Blanco. Water samples collected during July 1974 did not indicate the presence of any unexpected radioactivity. Gross beta concentration were below 10 pCi/1. Tritium was measured in four samples by electrolytic enrichment followed by liquid scintillation counting. Concentrations of tritium ranged from 0.14 ± 0.08 to 0.49 ± 0.08 pCi/ml. This tritium is attributable to natural production in the atmosphere and worldwide fallout from weapons testing. This concentration is a small fraction of the peak in 1963 caused by weapons testing in the atmosphere. Gamma emitters were not detected by gamma spectrometry in any of the samples. Gamma emitters other than natural K-40 were not detected in three milk samples collected in July 1974. (auth)

3329 NATURAL γ-RAY BACKGROUND MEASURED WITH Ge(Li) DETECTOR. Mosulishvili, L. M.; Kharabadze, N. E.; Tevzieva, T. K. Sov. At. Energy (Engl. Transl.); 35: No. 4, 941-942(Oct 1973).

Translated from At. Energ. (USSR); 35: No. 4, 275-276(Oct 1973).

A detailed study was made of the spectral composition of the natural background at the nuclear reactor of the Institute of Physics, Academy of Sciences, Georgian SSR during 1971 to 1972. A set of radioisotopes that produced one or more lines in the background spectrum was determined. (MCG)

3330 ACTUAL PROBLEMS OF ENVIRONMENTAL PROTECTION IN ENERGY PRODUCTION WITH CONSIDERATION OF THE RELATION BETWEEN ENVIRONMENTAL PROTECTION AND RADIATION PROTECTION. Rausch, L. (Abteilung fuer Experimentelle Radiologie und Strahlenschutz, Giessen, Ger.). pp 1-17 of Umweltschutz bei nuklearer und konventioneller energiegewinnung. Braun, H. (ed.). Stuttgart; Georg Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

The foundation of the concept of the meeting is briefly outlined. A personal evaluation is made of the important aspects of environmental protection and a brief outline of the topics to be discussed is given. The most important questions concerning the biological-medical evaluation of nuclear technology development are indicated. (JSR)

3331 ANALYTICAL METHODS OF ENVIRONMENTAL MONITORING. Sansoni, B. (Institut fuer Strahlenschutz, Neuherberg, Ger.). pp 238-258 of Umweltschutz bei nuklearer und konventioneller energiegewinnung. Braun, H. (ed.). Stuttgart; Geog Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971).. See CONF-711086-.

The factors forming the human environment and the changes made in his environment by man are briefly discussed. Environmental monitoring methods developed for radionuclides, elements, molecules or chemical compounds, ions, phases, and mixed phases are described. These include trace analysis, sampling, ashing, enrichment and separation, and preparation of measurement samples. The devices and techniques used in these methods are briefly considered. Data processing methods are indicated. (JSR)

3332 RADIOACTIVITY OF BUILDING MATERIALS AND RADIATION BACKGROUND OF BUILDINGS. Safonov, I. S. Energ. Stroit. Rubezhom; No. 4, 17-19(1972). (In Russian).

Natural radioactive isotopes in some quantity are in all construction materials without exception. The problem has special significance at present because of the parameters of the radiation background in buildings where new construction materials based on the slags and wastes of energy and metallurgical industry are finding wide utilization. Data are presented on the level of the γ background in buildings of different construction materials and the size of the radiation dose in the lungs of inhabitants. Data on the increased concentration of radioisotopes in slags and wastes are given. The construction materials having the highest specific γ activity were established as furnace and blast furnace slags and granite. The lowest activity was found in gravel, cement, concrete, sand, gypsum, lime, chalk, sandstone, and marble. (tr-auth)

3333 PROCEEDINGS OF THE SEMINAR ON THE MONITORING OF RADIOACTIVE EFFLUENTS, KARLSRUHE, GERMANY, MAY 14-17, 1974. Paris; Organisation for Economic Co-operation and Development (1974). 446p. (In French and English). (CONF-740556-). $11.00.

Separate abstracts were prepared for each of the 29 papers and the conclusions of the panel. (MCG)

For abstracts of individual papers see: 2844, 3334–3357, 3376, 4044, 5170, 5198, and 5292.

3334 OBJECTIVES OF RADIOACTIVE EFFLUENT MONITORING. Mehl, J. (Federal Ministry of Interior, Bonn). pp 10-15 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From Seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

Recommendations of ICRP concerning environmental contamination are discussed. It is emphasized that environmental monitoring is required only if the environment is significantly altered by release of radioactive material. The following objectives of environmental monitoring are listed: it should provide information on the extent to which from radioactive substances actually released, the environment could be altered with respect to radiation hazards; it should provide information to be used in deciding whether, or at least the extent to which, environmental monitoring should be applied; it should provide information which is sufficient to serve the purposes for which otherwise environmental monitoring is applied. (HLW)

3335 FRENCH REGULATIONS AND PROCEDURES PERTAINING TO DISCHARGES OF RADIOACTIVE EFFLUENTS. Chanteur, J.; Ervet, P. (SCPRI, Le Vesinet, France). pp 19-27 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974). (In French).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

French regulations regarding discharges of radioactive effluents and the monitoring of radioactive pollution of the environment are summarized and discussed. Principles applied in the authorization and supervision of radioactive discharges from basic nuclear installations are considered. Finally, as an example, the arrangements made for a recently commissioned nuclear power station are described; these arrangements will be used as a basis for harmonizing regulations now being promulgated. (auth)

3336 UNITED STATES ATOMIC ENERGY COMMISSION PROGRAM FOR THE CONTROL, MONITORING, AND REPORTING OF RADIOACTIVITY IN EFFLUENTS. Biles, M. B.; Coffman, F. E. (Atomic Energy Commission, Washington, DC). pp 28-49 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

Effluent monitoring and reporting programs are maintained at all U.S. Atomic Energy Commission (AEC) facilities discharging concentrations of radioactivity which have potential health and safety or environmental significance. The objective of these programs is to assure effective management and control of effluents. The nature and quantities of radioactivity discharged to the environment vary widely from site to site, primarily due to the wide variety of operations and facilities. Effluent control programs at AEC sites are based primarily on guidance promulgated by the ICRP, the NCRP, and the FRC. An Effluent Reduction Program, focusing on the reduction of quantities, rather than concentrations, of radioactivity was instituted in late 1970 and has resulted in substantial reductions in quantities of radioactivity released from selected facilities. To maintain an overview of its effluent control practices, the AEC has developed and instituted a computer-based annual effluent data reporting system to assure that effluent control programs are properly maintained. This system has proven to be a very useful internal management tool for evaluating the effectiveness of effluent control programs and for identifying potential problem areas. (auth)

3337 REGULATIONS AND PRACTICES FOR THE CONTROL OF RADIOACTIVE WASTE IN BELGIUM. Cantillon, G. E. (Famille et de l'Environnement, Brussels); Stallaert, P. pp 50-60 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974). (In French).

From Seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

The Belgian legislation that applies to the liquid and gaseous radioactive releases is mentioned and discussed. Its application to the releases of the nuclear power plants located in Doel and Tihange is briefly explained. (auth)

3338 PRACTICES AND REGULATIONS ON THE CONTROL OF RADIOACTIVE EFFLUENTS IN ITALY. De Cecco, G. (CNEN, Rome). pp 61-72 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

The technical and administrative problems of control that public authorities in Italy exercise over radioactive effluents released from nuclear plants are reviewed. Beginning with the illustration of the qualifying points concerning the environment included in the Italian nuclear laws, the basic criteria at present adopted in Italy for the definition and surveillance of the discharge limits for radioactive effluents are outlined. Finally a method to define practical reference levels of radioactive contamination in environmental samples collected for surveillance purposes around nuclear sites is considered. (auth)

3339 MONITORING OF RADIOACTIVE GASEOUS EFFLUENTS DISCHARGED FROM NUCLEAR INSTALLATIONS IN THE UNITED KINGDOM. Carr, J. A. (Ministry of Agriculture Fisheries and Food, London); Stott, G. pp 73-80 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

The principles governing the control of emissions of radioactive gases to atmosphere from nuclear sites in the United Kingdom are discussed. Specific limits for the radionuclides discharged are not usually detailed by the authorizing departments who generally prefer to rely on the "best practicable means" approach to minimize emissions. (auth)

3340 MONITORING OF RADIOACTIVE GASEOUS EFFLUENTS FROM NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC OF GERMANY. Schwibach, J.; Winkelmann, I. pp 81-109 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

Monitoring of radioactive gaseous effluents from nuclear power plants must prove that applicable radiation protection standards and licensing conditions are met, that the actual discharge of radionuclide substances may be reported to the public, and that any accidental release of radionuclides may be detected immediately. Therefore, the total activity of radioactive substances in the gaseous effluents must be determined continuously by direct measurement prior to discharge, whereas radionuclide mixtures or single radionuclides which may contribute significantly to the radiation exposure of the public, even if amounting only to a very minor fraction of the total activity discharged, may be determined separately by continuous or discontinuous sampling and measuring methods which provide the necessary detection limit. The control of the discharge of radioactive gaseous effluents shall be completed by environmental monitoring in the vicinity of the nuclear power plant. (auth)

3341 MONITORING OF RADIOACTIVE LIQUID EFFLUENT DISCHARGED INTO THE ENVIRONMENT FROM NUCLEAR INSTALLATIONS IN THE UNITED KINGDOM. Stott, G. (Scottish Development Dept., Edinburgh); Hetherington, J. A. pp 110-126 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

In the United Kingdom the disposal of radioactive liquid waste into the environment from nuclear sites is formally authorized. The monitoring of such effluent streams prior to discharge is necessary for a number of reasons. The philosophy of the United Kingdom authorizing departments in requiring pre-discharge monitoring of liquid effluents by nuclear site operators is described. Sources of wastes and isotopic analyses of some effluents are discussed. (auth)

3342 REGULATION OF THE RELEASE OF RADIOACTIVE WASTE WATER FROM NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC OF GERMANY. Aurand, K. (Bundesgesundheitsamtes, Berlin-Dahlem, Ger.). pp 127-137 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

In the Federal Republic of Germany the regulation of the discharge of radioactive effluents from nuclear power plants is based on the principle of keeping the releases as low as possible. Rules for the discharge of radioactive waste water adopted for licensing procedures of nuclear power installations demand the following control measures: collection of all the waste water possibly contaminated radioactively; inhibition of discharge if the activity concentration exceeds 5×10^{-4} Ci/m^3; storage of samples of each discharge; determination of the released activities of the different radionuclides; annual discharge limits; continuous γ-counting in the discharge line and the outlet of the cooling water; continuous water sampling from the inlet and outlet of the cooling water. (auth)

3343 U. S. ATOMIC ENERGY COMMISSION REGULATORY PROGRAM FOR THE CONTROL MONITORING AND REPORTING OF RADIOACTIVITY IN EFFLUENTS: AN OVERVIEW. Higginbotham, L. B.; Collins, J. T. (Atomic Energy Commission, Washington, DC). pp 138-150 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

Programs for control and monitoring of radioactive effluents are required at all facilities regulated by the U. S. Atomic Energy Commission (AEC). Limitations and requirements for control and monitoring of radioactive effluents are expressed in AEC Regulations issued under Title 10, Code of Federal Regulations. AEC regulations and policies for control of exposures from radiation and radioactive materials are based primarily on guidance promulgated by the ICRP, the NCRP, and the FRC. Conditions in operating licenses issued by AEC Regulatory require appropriate surveillance and monitoring programs as a basis for demonstrating compliance with AEC regulatory limits for the release of radioactive effluents. (auth)

3344 MONITORING OF GASEOUS EFFLUENTS FROM SEVERAL INSTALLATIONS AT THE PETTEN RESEARCH CENTRE. Stoute, J. R. D. (Reactor Centrum Nederland, Petten). pp 153-165 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

The paper deals with the current practices of monitoring the gaseous and liquid effluents from several installations, such as a pool-type research reactor (45 MWatt) of Euratom, a waste treatment plant, a radio-chemistry building and a hot-laboratory of R.C.N. and an isotope production plant owned by Philips Duphar. Information is given about monitors for noble gases, aerosols and radio-iodine species as well as about monitoring the liquid wastes which are released into the North Sea. (auth)

3345 REGULATIONS AND CURRENT PRACTICES ON MONITORING ENVIRONMENTAL RELEASES FROM MAJOR NUCLEAR INSTALLATIONS IN INDIA. Bhat, I. S. (Bhabha Atomic Research Centre, Bombay). pp 166-176 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

Nuclear installations like power reactors, fuel reprocessing plants, and uranium production plants in India have controlled releases of low level radioactive liquid and gaseous wastes to the environment. These environmental releases are rigorously monitored before release. The regulations on environmental releases are formulated by a separate organization than plant operation. The limits on releases and current practice of effluent monitoring at the nuclear power stations at Tarapur and Kota, Rajasthan are discussed in the paper. (auth)

3346 EXPERIENCE IN COMPLYING WITH AUTHORIZATION CONDITIONS FOR THE DISCHARGE OF LIQUID AND GASEOUS RADIOACTIVE EFFLUENTS FROM CEGB NUCLEAR POWER STATIONS. Pepper, R. B. (Central Electricity Generating Board, London). pp 180-190 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

For each of its 8 operational twin-reactor magnox sites, the Central Electricity Generating Board has been granted separate authorizations for liquid and gaseous radioactive discharges. The conditions attached to the authorizations differ only in detail from station-to-station. An outline is given of the manner in which the Board comply with those conditions relating to the monitoring of effluents. Reference is made to problems in monitoring and evaluation which have arisen because of changes in plant operating conditions, and in reactor and plant design. As a result of the regular re-assessment of techniques in use, the Board is satisfied that it has continued to comply with the authorization conditions. (auth)

3347 MONITORING OF THE RADIOACTIVE EFFLUENTS FROM THE EUROCHEMIC FUEL REPROCESSING PLANT. Gustafsson, B.; Osipenco, A. (Societe Eurochemic, Mol, Belg.). pp 191-202 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

The plant is described and the main characteristics of the reprocessed fuel are given. The gaseous effluents are released via an 80 m stack, after filtration. The allowed releases are based on MPC's and a determined atmospheric diffusion factor. The sampling and monitoring system are described. Main results for yearly discharges are given. No liquid effluents are directly released. The low level liquid wastes are transferred to the waste treatment installations of CEN/Belgonucléaire via pipe-lines. Controls are performed in order to ensure that given contractual limitations are enforced. Liquid wastes with an activity higher than the accepted limits are concentrated and stored on site. (auth)

3348 MONITORING OF RADIOACTIVE GASEOUS EFFLUENTS IN THE GERMAN REPROCESSING PLANT WAK. Finsterwalder, L.; Hoffmann, W.; Huppert, K. L. (Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen mbH, Leopoldshafen, Ger.). pp 203-212 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

A description of the WAK off-gas monitoring system is given. All medium and low active liquid wastes of the plant are transferred to the effluent treatment station of the Nuclear Research Center Karlsruhe, and no liquid active effluents are directly released to the environment. The gaseous effluents from room and vessel ventilation systems are continuously monitored for aerosols and radioactive gases (noble gases and iodine). Tritium is determined by sampling of condensate in the off-gas stream. Operating experiences with the monitoring station are reported. (auth)

3349 MONITORING OF RADIOACTIVE GASEOUS EFFLUENTS FROM HTR-FUEL REPROCESSING PLANTS AND STORAGE FACILITIES. Filss, P.; Laser, M.; Merz, E.; Wolf, J. (Kernforschungsanlage, Juelich, Ger.). pp 213-228 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

The principal gaseous wastes in reprocessing of fuel elements from high-temperature gas-cooled reactors (HTR's) arise from the burning head-end step, from the fuel dissolution operation, from the fission product solidification, and from the air used to ventilate hot cell facilities including spent fuel storage. Radioactive particulates and aerosols may be involved as well as iodine-131, iodine-129, tritium and radioactive noble gases such as krypton-85. Emissions of particulate and entrained radioactivity as well as krypton and tritium are kept to a low level by using specially designed gas cleaning and retainment equipment. In order to attain a better internal process control and also a higher detection sensitivity, a special monitoring system is proposed for the gaseous effluents from a HTR-reprocessing plant. The main feature is the independent measurement of the few crucial undiluted off-gas streams close to their origin of generation in correlation with the central stack monitoring. Details of the particular measurements and procedures are presented. (auth)

3350 GASEOUS EFFLUENT MONITORING IN ONTARIO HYDRO HEAVY WATER POWER REACTORS. Watson, D. A.; Wilson, R.; Kabat, M. (Ontario Hydro, Pickering). pp 229-244 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

Gaseous effluent monitoring in Ontario Hydro is carried out for noble gases, tritium, radioiodine and mixed particulate activity. The current monitoring practices for these radionuclide groups are reviewed with special emphasis on: the measurement of mixed fission product noble gases in gamma-Curie-MeV units, the measurement of tritium using silica gel samplers and water bubblers, the collection and measurement of various forms of radioiodine using a monitor developed to compensate for external gamma fields and noble gases trapped in the charcoal cartridge. Calibration procedures are discussed and the computer based daily reporting system in use at Pickering G. S. is described. (auth)

3351 HEALTH AND TECHNICAL CONSIDERATIONS RELATIVE TO THE CONTROL OF GASEOUS WASTES FROM NUCLEAR POWER PLANTS. Fitoussi, L. (CEA, Fontenay-aux-Roses, France). pp 245-258 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974). (In French).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

The nature and importance of the radioactive risks of the gaseous releases from a nuclear power plant are analyzed and attention is focused on the preponderant radioactive risk and the populations concerned. For the monitoring of the releases and the evaluation of their consequences, a simple measuring device is proposed. This device used with appropriate models, allows the direct calculation of the ground level external irradiation. The generalization of this technique would make the comparison of the results easier if the correspondence factors $\text{rem}\cdot\text{h}^{-1}/\text{Ci}\cdot\text{m}^{-3}$ met with general agreement. (auth)

3352 CONTINUOUS SAMPLING FOR DETECTION OF WATER BOUND TRITIUM IN EXHAUST AIR. Koenig, L. A.; Wilhelm, J. G.; Dillmann, H. G. (Kernforschungszentrum, Karlsruhe, Ger.). pp 275-282 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

The discontinuous measurement of HTO releases via the exhaust air of nuclear plants by continuous sampling is described. For sampling a partial stream of the exhaust air is picked up in a central position of the exhaust channel or stack and cooled down to a temperature near the freezing point in a coil condenser. The condensate drops into a collector from which samples can be taken at random intervals. Subsequently, the partial stream is recycled into the exhaust system through a pump. The method conveniently allows existing environmental contamination by tritium to be recorded and is applicable in cases where direct measurement lacks sensitivity or is ruled out on account of the prevailing conditions (high radiation level at the location of the measuring instrument, admixtures of radioactive noble gases or aggressive chemical substances in the exhaust air, temperature of the exhaust air). Previous operating experience is briefly reported. (auth)

3353 MONITORING RADIOACTIVE EFFLUENTS BY LARGE AREA PLASTIC SCINTILLATORS: A POSSIBILITY FOR STANDARDIZATION. Barz, H. G.; Bochardt, K. D.; Hacke, J. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). pp 293-302 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

The monitoring of radioactive effluents released from a 5 MW swimming pool reactor is described. Plastic scintillation detectors mounted in special bypass chambers are used. Data are given regarding calibration and sensitivities for β-particles and γ-radiation. The activity concentration as well as the total activity released can be determined directly. If necessary, background reduction can be obtained by use of a conventional compensation method. The advantages of plastic scintillation detectors compared with GM-tubes are discussed. (auth)

3354 MONITORING OF THE AERIAL AND LIQUID RADIOACTIVE EFFLUENTS FROM BNFL, WINDSCALE. Hermiston, S. T. (British Nuclear Fuels Ltd., Windscale, Eng.). pp 316-327 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

The relationship between monitoring radioactive effluents and the nature of the processes which produce the effluents is considered. The following sources of radioactive effluents are discussed: magnox fuel receipt building; the chemical reprocessing building where plutonium, uranium, and aqueous raffinate streams are produced; the plutonium finishing plant; the Head End Treatment Plant; the plutonium fuel element manufacturing building; and the technical laboratories. Calculation of Derived Working Limits for stacks relative to Dose Limits prescribed by the ICRP are discussed. Problems encountered in stack sampling and analysis of samples are described. Regulations concerning limits on the curie content of liquid effluents discharged to the sea are discussed. Restrictions on the amounts of ^{106}Ru, ^{90}Sr, and ^{144}Ce as well as beta and alpha limits are pointed out. (HLW)

3355 CONTINUOUS MONITORING OF RADIOACTIVE CONTAMINATION IN SUSPICIOUS EFFLUENTS. Peray, R.; Juste, G.; Descamps, A. (CEN de Cadarache, St. Paul les Durance, France). pp 328-341 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974). (In French).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

A description of a radioactive monitoring system for suspicious effluents at the Active Fuel Examination Laboratory of the Cadarache Centre d'Etudes Nucléaires is given. With this facility it is possible continuously to monitor suspicious effluents for radioactivity, and there is an automatic system for diverting effluents into active storage tanks in the event of the prescribed limits being exceeded, or for reasons of safety. (auth)

3356 MONITORING OF RADIOACTIVE LIQUID EFFLUENTS AT THE KARLSRUHE NUCLEAR RESEARCH CENTER. Winter, M. (Kernforschungszentrum, Karlsruhe, Ger.). pp 342-359 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

Some 4 × 10^5 m^3 of liquid effluents are produced annually at the Karlsruhe Nuclear Research Center. The activity control measurements performed by the liquid effluents laboratory of the Radiation Protection and Safety Department decide on the release of these liquid effluents within the meaning of the applicable stipulations. The structure and objectives of liquid effluent monitoring are described. It is reported on the measurement techniques employed and on the extent and results of monitoring measurements. (auth)

3357 PANEL: CONCLUSIONS OF THE SEMINAR. pp 399-429 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

The five chairmen of the seminar discussed their views and conclusions of the conference. Some topics discussed were: predischarge monitoring of liquid effluents; problems of sampling and analyzing gaseous effluents; purposes of effluent monitoring; concepts of population dose; standardization of measurement methods; emergency planning; regulations for radiation exposure; recommendations of the ICRP; and cost-benefit analyses. (HLW)

3358 NUCLEAR ENERGY DEVELOPMENT AND ENVIRONMENTAL PROTECTION (A SUMMARY). Gedeonov, L. I.; Trusow, A. G. Arch. Energiewirt.; 28: No. 8, 386-405(Apr 1974). (In German).

5 tabs.; 57 refs. Also published in Russian in At. Tekh. Rubezhom, 1973, no. 12, p. 22-33.

The development of nuclear energy in the world and its influence on the environment, including reprocessing plants and waste storage are surveyed. (GE)

3359 TRITIUM IN NATURE. I. Origin, Distribution, and Methods of Counting. Povinec, P. (Komenskeho Univ., Bratislava). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; 13: 251-275(1973).

The natural and artificial sources of tritium, its transport from stratosphere to troposphere, hydrosphere and biosphere, and forms of tritium existence in reservoirs were studied. The methods of low level counting of tritium are discussed and the comparison of gas counters with liquid scintillation counters shows that the former is advantageous to use for activity measurements less than 100 TU and the latter for higher activity. (auth)

Atmosphere

Refer also to abstracts 3316, 3454, 3479, 3705, and 5539.

3360 (ARMS-69.6.4) AERIAL RADIOLOGICAL MEASURING SURVEY OF THE INDIAN POINT STATION, AUGUST 1969. (EG and G, Inc., Las Vegas, Nev. (USA)). Jul 1974. 15p. Dep. NTIS $4.00.

The Aerial Radiological Measuring System (ARMS) was used to survey the area surrounding the Indian Point Station during August 1969. The survey measured terrestrial background γ radiation and included an attempt to detect stack release gases. A high-sensitivity detection system collected γ spectral and gross-count data. The data were then computer processed into a map of a 625 square mile area showing isoexposure contours three feet above the ground. Exposure rates and isotopes identified in the area survey were generally consistent with normal terrestrial background. A single point source of low energy photons, possibly an x-ray machine, was observed near the edge of the area. The plume assay revealed no radioactivity other than normal background. (auth)

3361 (ARMS-71.6.2) AERIAL RADIOLOGICAL MEASURING SURVEY OF THE PRAIRIE ISLAND NUCLEAR GENERATING PLANT, SEPTEMBER 1971. (EG and G, Inc., Las Vegas, Nev. (USA)). Aug 1974. 15p. Dep. NTIS $4.00.

The Aerial Radiological Measuring System (ARMS) was used to survey the area surrounding the Prairie Island Nuclear Generating Plant during September 1971, prior to reactor start-up. The survey measured terrestrial γ radiation. A high-sensitivity detection system collected γ spectral and gross-count data. The data were then computer processed into a map of an 800 square mile area showing isoexposure contours three feet above the ground. Exposure rates and isotopes identified are consistent with normal terrestrial background radiation. (auth)

3362 (ARMS-71.6.4) AERIAL RADIOLOGICAL MEASURING SURVEY OF THE PILGRIM STATION, SEPTEMBER 1971. (EG and G, Inc., Las Vegas, Nev. (USA)). Aug 1974. 15p. Dep. NTIS $4.00.

The Aerial Radiological Measuring System (ARMS) was used to survey the area surrounding the Pilgrim nuclear power station during September 1971, prior to reactor start-up. The survey measured terrestrial background γ radiation. A high-sensitivity detection system collected γ-ray spectral and gross-count data. The data were then computer processed into a map of a 230 square mile area showing isoexposure contours three feet above the ground. Exposure rates and isotopes identified are consistent with normal terrestrial background radiation. (auth)

3363 (ARMS-72.6.5) AERIAL RADIOLOGICAL MEASURING SURVEY OF THE COOPER NUCLEAR STATION, AUGUST 1972. (EG and G, Inc., Las Vegas, Nev. (USA)). Aug 1974. 18p. Dep. NTIS $4.00.

A description is given of the aerial radiological measuring system used to survey the area surrounding the Cooper Nuclear Station during August 1972, prior to reactor start-up. The survey measured terrestrial gamma radiation. A high-sensitivity detection system collected gamma-ray spectral and gross-count data. The data were then computer processed into a map of a 700 square mile area showing isoexposure contours three feet above the ground. Exposure rates and isotopes identified are consistent with normal terrestrial background radiation. (auth)

3364 (ARMS-72.6.9) AERIAL RADIOLOGICAL MEASURING SURVEY OF THE FORT ST. VRAIN NUCLEAR GENERATING STATION, OCTOBER 1971. (EG and G, Inc., Las Vegas, Nev. (USA)). Aug 1974. 15p. Dep. NTIS $4.00.

The Aerial Radiological Measuring System (ARMS) was used to survey the area surrounding the Fort St. Vrain Nuclear Generating Station during October 1972, prior to reactor start-up. The survey measured terrestrial γ radiation. A high-sensitivity detection system collected γ spectral and gross-count data. The data were then computer processed into a map of a 670 square mile area showing isoexposure contours three feet above the ground. Exposure rates and isotopes identified are consistent with normal terrestrial background radiation. (auth)

3365 (BNWL-SA-5061) ATMOSPHERIC AEROSOLS: SOURCES, CONCENTRATIONS, AND BUDGETS. Slinn, W. G. N. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 12 Aug 1974. Contract AT(45-1)-1830. 17p. (CONF-740921-15). Dep. NTIS $4.00.

From atmosphere-surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

Problems related to studies on the diffusion of aerosols in surface air, particle size measurements, and particle deposition are discussed. (auth)

3366 (BNWL-SA-5062) PRECIPITATION SCAVENGING: SOME PROBLEMS, APPROXIMATE SOLUTIONS AND SUGGESTIONS FOR FUTURE RESEARCH. Slinn, W. G. N. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1974. Contract AT(45-1)-1830. 24p. (CONF-741003-3). Dep. NTIS $4.25.

From precipitation scavenging conference; Champaign, Illinois, USA (13 Oct 1974).

Problems in studies of precipitation scavenging of atmospheric particles are reviewed. Definitions of terms and mathematical models used in studies of precipitation scavenging are discussed critically. (CH)

3367 (BNWL-SA-5085) RESUSPENSION OF PLUTONIUM AT ROCKY FLATS. Sehmel, G. A.; Lloyd, F. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1974. Contract AT(45-1)-1830. 39p. (CONF-740921-11). Dep. NTIS $5.00.

From atmosphere–surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

In a July, 1973 field experiment at Rocky Flats, vertical airborne plutonium concentrations were determined as a function of respirable particle size. The principal sampling site was a 100-ft meteorological tower which was instrumented at several heights with self-orienting, high volume cascade impactor-cowl systems. Wind speed instrumentation activated selected impactors as a function of wind speed. Airborne plutonium concentrations and concentrations on airbonne soil were measured as a function of both height and wind speed. Below 10 m concentrations decreased with height. Above this height to 30 m, an increase suggested that an elevated upwind source could be contributing. The maximum airborne concentration measured was 3.7×10^{-15} Ci/m^3. The maximum concentration per gram of gross airborne soil was 50 pCi/g. Somewhat higher concentration was found on the ~ 2 μm airborne soil fraction. All concentrations were significantly less than maximum permissible concentrations. (auth)

3368 (BNWL-SA-5124) PARTICLE RESUSPENSION RATES. Sehmel, G. A.; Lloyd, F. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1974. Contract AT(45-1)-1830. 14p. (CONF-740921-12). Dep. NTIS $4.00.

From atmosphere–surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

Particle resuspension rates were measured during four months of field testing in a lightly vegetated area. Resuspension of an inert submicrometer tracer placed on the ground in a circle of 29 m radius was measured. At the circle center, airborne concentrations were measured to heights of 6.1 m. The resuspended plume extended above 6.1 m. Resuspension rates were from 10^{-10} to 10^{-8} fraction resuspended/sec. Resuspension rates increased non-linearly as a function of wind speed. For wind speeds greater than 3.6 m/sec, resuspension rates increased with wind speed to the 6.5 power. (auth)

3369 (HASL-287, pp 100-117) DIURNAL VARIATION OF THE RADON-222 CONCENTRATION IN RESIDENTIAL STRUCTURES IN GRAND JUNCTION, COLORADO. Spitz, H. B.; Wrenn, M. E. (New York Univ. Medical Center, Tuxedo, NY). Sep 1974.

From 2nd environmental radiation workshop; New York, New York, USA (20 Feb 1974).

In second workshop on the natural radiation environment (February 1974).

Several residential structures in Grand Junction, Colorado, have elevated ^{222}Rn levels due to the presence of uranium mill tailings in the construction materials. It has been estimated that about 3×10^5 tons of tailings have been used from the Climax Mill in Grand Junction, of which about 5×10^4 tons have actually been incorporated in the construction of residential structures. In all, about 4800 residences have tailings under or near the foundation. Preliminary results are presented from an investigation into the diurnal variations of ^{222}Rn concentrations in houses in Grand Junction, Colorado. (CH)

3370 (HASL-287, pp 128-139) GROUND-LEVEL AIR CONCENTRATIONS OF NATURAL AND MAN-MADE RADIONUCLIDES. Palms, J. M.; Tanner, B. K.; Wood, R. E. (Emory Univ., Atlanta). Sep 1974.

From 2nd environmental radiation workshop; New York, New York, USA (20 Feb 1974).

In second workshop on the natural radiation environment (February 1974).

In order to assess the environmental impact of man-made releases of radionuclides it is essential to better understand the baseline ground-level air concentrations of radionuclides and their geographic and temporal variations. The main constituents of presently found ground-level air concentrations of radionuclides are those resulting from world-wide nuclear weapons testing and from natural processes. The nuclear weapon radionuclides consist of fission-produced and neutron-induced activity from weapon component materials. The natural radionuclides include the gaseous (radon) members of the terrestrial naturally occurring series, the natural radionuclides in the airborne dust, and the cosmic-ray-produced radionuclides which result from spallation reactions in the atmosphere. Many of these nuclides are also found in gaseous effluent releases of the nuclear industry. The ideal study of ground-level airborne radionuclides would have the capability of dynamically measuring the time-varying concentrations of each radionuclide present. Since this is neither practical nor possible, a combination of measurements which almost satisfies the ideal goals is usually adopted. These measurements consist of the following: a series of integrated air filter measurements with γ spectrometric analysis of the filter; tritium, HTO, and HT determinations using silica gel and a hydrogen catalytic combustion-absorber technique, respectively; gross radiation field measurements using high pressure ionization chambers, and spectrometric environmental γ-ray level measurements using either NaI(Tl) or Ge(Li) spectrometers in situ. A brief summary of integrated air filter measurements made during 1972 and 1973 at Barnwell, S. C. and vicinity (33.14°N latitude) is presented. Radionuclide measurements were made more than three days after air collection ceased to allow for the deterioration of short lived radon products. (CH)

3371 (HASL-287, pp 140-147) MODEL FOR ESTIMATING VARIATIONS IN TERRESTRIAL RADIATION EXPOSURES BASED ON SOIL–WATER BALANCE. Burke, G. deP. (USAEC Health and Safety Lab., New York). Sep 1974.

From 2nd environmental radiation workshop; New York, New York, USA (20 Feb 1974).

In second workshop on the natural radiation environment (February 1974).

The need for proper interpretation of total environmental radiation exposure measurements made with integrating detectors such as thermoluminescence dosimeters (TLD) in the vicinity of nuclear reactors has stimulated increased interest in the variations with time and location of natural environmental radiation exposures. Total exposure measurements include contributions from cosmic radiation, fallout, and terrestrial γ radiation resulting from distributed fallout and naturally occurring radionuclides within the ground. Each component of this radiation background varies with both time and location. Any exposure attributable to the operation of a nuclear facility will be superimposed upon this variable background and will itself vary with time and/or location, depending on the gaseous effluent release rates, local meteorological conditions, and the distance and direction from the stack of the measurement locations. Thus the extraction of the component attributable to plant operation from a total exposure measurement is not a simple task. A mathematical model is described for estimating changes in background radiation with time and location. For the purpose of characterizing the variations it was assumed that the exposure above the ground due to terrestrial γ radiation is affected by density changes in the soil-water medium and the shielding effects of water, ice, or snow on the surface. The climatic data required for the solution of the equations is discussed. (CH)

3372 (LA-UR-74-1340) MODEL FOR PREDICTING THE REDISTRIBUTION OF PARTICULATE CONTAMINANTS FROM SOIL SURFACES. Travis, J. R. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 59p. (CONF-740921-16). Dep. NTIS $6.00.

From atmosphere–surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

A computerized model was developed to describe the redistribution of wind eroding soil-contaminant mixtures. Potentially mobil particulate contaminants can, in the first approximation, be assumed to be indistinguishable from the wind eroding soil in which they are distributed. A grid network characterizes important soil and surface conditions, and mass conserving control volumes are constructed on each cell. Material is transported through the vertical and top surfaces of a control volume by a modified Bagnold-Chepil horizontal flux formulation and modified Gillette vertical flux formulation, respectively. The vertical emissions, considered as puffs from area sources, create at regular time intervals a contaminant cloud which is proportional to the suspendable ground concentration. These puffs diffuse downwind under time dependent wind velocity and atmospheric stability conditions, maintaining during the time interval a three-dimensional Gaussian distribution of concentration with cloud volume. Material from each puff is deposited in downwind cells, leading to the possibility of many different flights from these new sources. The usefulness of this predictive tool is demonstrated by calculations involving mixtures of particulate ^{238}PuO$_2$ in highly erodable soils under dust storm conditions. Time dependent surface concentration and breathing zone exposure isopleths, evolving from a small contaminated area, show the potential hazard from wind eroding toxic materials. (auth)

3373 (LNF-74/38(R)) EXPERIMENT ON THE PHYSICAL OBSERVATION OF RADIATIONS AT THE BOUNDARY OF THE

FRASCATI CENTER. Lucci, F.; Pelliccioni, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 8 Jul 1974. 20p. (In Italian). Dep. NTIS (US Sales Only) $4.00.

The radiation in the area surrounding the Frascati laboratory with free access to the public is of continuing concern. The maximum permissible dose for population exposure is first defined. The criteria followed at Frascati to limit the radiation exposure in this free-access area are outlined and the monitoring system developed is briefly described. The dosimetric values obtained in the last five years are given and discussed. The levels of γ radiation at the boundary of the laboratory area and the natural radioactivity of the region are determined. The levels of neutron radiation at great distances and at the boundaries are given. It is concluded that the γ dose at the boundaries is negligible. The contribution of the neutron dose is between 10 and 40 mrem/year at a distance of 100 m from the accelerators and between 2 and 12 mrem/year at 200 m. (JSR)

3374 (RS-43/102) RADIOACTIVE FALLOUT FROM THE EXPLOSIONS IN THE PACIFIC OCEAN IN THE PERIOD 1971-1972. Beninson, D.; Migliori de Beninson, A.; Menossi, C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 11p. (In Spanish). Dep. NTIS (US Sales Only) $4.00.

Data are presented on the content of ^{144}Ce, ^{131}I, ^{103}Ru, ^{95}Zr, ^{95}Nb, and ^{140}Ba in fallout samples collected in air in Argentina during 1971 and 1972 following nuclear tests in the Pacific Ocean. The radiation dose to the thyroid of man following uptake of ^{131}I from milk was calculated as 8 mrad/yr and the external radiation dose to the human population was calculated to be 1.8 mrad/yr. (CH)

3375 (TT-74-50011) NUCLEAR METEOROLOGY. Makhonko, K. P.; Malakhov, S. G. Translated by A. Barach and H. Olaru from Tr., Inst. Eksp. Meteorol.; No. 21-25, vp(1971). 388p. (CONF-690670-). NTIS $8.25.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The papers in this collection were read at the all-union conference on nuclear meteorology held on 23 to 28 June 1969 at the Institute of Experimental Meteorology in the town Obninsk. The following are the main topics discussed at the conference: use of radioactive tracers in meteorological investigations; global contamination of the atmosphere and fallout of radioactive products of nuclear blasts; natural radioactivity of the atmosphere; atmospheric scavenging of radioactive contaminants; formation of radioactive aerosols and their properties; and equipment and procedures used for studying radioactive contamination of the environment. (GRA)

3376 DEVELOPMENT OF A MONITORING FILTER FOR IODINE. Garder, K.; Vagslid, T. (Institutt for Atomenergi, Kjeller, Norway). pp 283-292 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

The development of a monitoring filter for iodine involved tests with various types of charcoal and the design and testing of a suitable filter cartridge. The charcoal filters were tested under conditions similar to those under which they would be used. An attempt was made to obtain an absolute measurement of the filter efficiency by comparing the accumulated ^{131}I activity on the charcoal filters with measurements of ^{131}I in air samples with vacuum jars. This method allowed determination of the filter efficiency under the varying operating conditions normally encountered in practice at nuclear plants. A description of the filter is given. More than three years experience with the use of the filter for monitoring of gaseous effluents is discussed. (auth)

3377 SPECIAL METHODS OF RADIOACTIVE FALLOUT MEASUREMENT IN IRAQ. Usacev, S. (Komenskeho Univ., Bratislava). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; 13: 111-115(1973).

A method for measuring fallout in desert areas where there is little rainfall is described, and some results of measurements in Iraq are given. The sample is collected on a paraffin paper and counted with a G-M detector-scintillation counter anticoincidence unit. (WHK)

Soil

Refer also to abstract 3368.

3378 (BNWL-SA-5144) STATISTICAL DESIGN ASPECTS OF SAMPLING SOIL FOR PLUTONIUM. Gilbert, R. O.; Eberhardt, L. L.; Fowler, E. B.; Essington, E. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 29p. (CONF-740921-5). Dep. NTIS $4.50.

From atmosphere-surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

Some of the statistical aspects of the design of efficient soil sampling programs for estimating the inventory (total amount) and geographical distribution of $^{239-240}$Pu in surface soil are discussed. On-going experience with using stratified random sampling for estimating plutonium inventory in soils on "safety shot" sites on the Nevada Test Site (NTS) and the Tonopah Test Range (TTR) under the auspices of the Nevada Applies Ecology Group (NAEG) is emphasized. The NAEG is conducting plutonium environmental studies on these sites where past experiments involving plutonium devices and high explosives have resulted in plutonium contaminated soil. The information gained on the amounts and distribution of plutonium in soil will support the resuspension experiments currently underway at these sites. (auth)

3379 (HASL-287, pp 3-12) INHOMOGENEITIES OF RADIONUCLIDE DISTRIBUTIONS IN THE NATURAL ENVIRONMENT. Smith, A. R.; Wollenberg, H. A. (Univ. of California, Berkeley). Sep 1974.

From 2nd environmental radiation workshop; New York, New York, USA (20 Feb 1974).

In second workshop on the natural radiation environment (February 1974).

The natural terrestrial γ dose rates vary widely from place to place in California where the range of values observed in a partial survey of California according to bedrock type showed a range from 5 mr/yr to 315 mr/yr, or a 60-fold variation. In a sampling of the soils of the San Francisco Bay Area a range of 25 to 115 mr/yr, or almost a 5-fold variation, was found. Although spatial radiometric differences are well known as a type phenomenon, their existence and magnitude are usually not evident a priori, but must be determined for each site of interest. Detailed measurements reveal that variations of 2-fold are not unusual over distances of a few meters, as when one crosses the boundary between soils derived from two rock types that show sharp radiometric differences. Man's activities can produce sudden and dramatic changes in the ambient γ-radiation field that are much more capricious than those brought about by natural agencies. Any human activity that adds material to or removes material from a surface area larger than about one square yard, in amount greater than the equivalent of about 2 inches of soil, may cause a significant change in the ambient γ-radiation field. (CH)

3380 (LA-UR-74-1339) SAMPLING OF SOILS FOR RADIOACTIVITY: PHILOSOPHY, EXPERIENCE, AND RESULTS. Fowler, E. B.; Gilbert, R. O.; Essington, E. H. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 13p. (CONF-740921-4). Dep. NTIS $4.00.

From atmosphere-surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

Factors to be considered by the Nevada Applied Ecology Group are choice of analytical method, choice of sampling method, and choice of sample preparation method. The interaction of all persons concerned is emphasized. The two major sources of radioactive material in the environment are worldwide fallout and release from accidents. Special problems such as decontamination of equipment and proper labeling are pointed out. Controllable variables include cross-contamination, sample activity levels, and sampling stratification. Determination of areal levels and vertical distribution of radioactivity at the Nevada Test Site are discussed. Information obtained on 1800 soil samples serves as a basis for other divisions of the NAEG such as Resuspension, Field Ecology, Biological Studies, and Modeling as these relate to transfer of plutonium to man. (HLW)

Water

Refer also to abstract 2875.

3381 (BNWL-SA-5115) AIR-TO-SEA TRANSFER OF MARINE AEROSOL. Silker, W. B. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. Contract AT(45-1)-1830. 10p. (CONF-740921-14). Dep. NTIS $4.00.

From atmosphere-surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

It is important to know the rate at which radioactive material and airborne pollutants are transferred from the atmosphere to the ocean in order to be able to predict how much of these materials will be injected into the world's oceans. Using cosmogenic ^{7}Be which is produced in the atmosphere at a relatively constant rate as a tracer, ocean water was sampled during March

1971 and during August through December 1973 to determine the vertical distribution of ^{7}Be and the variation with latitude of ^{7}Be flux across the air–sea interface. It was found that the deposition velocity of the marine aerosol increases from about 1 cm/sec in the equatorial regions to nearly double that value at more northerly latitudes and that the deposition velocity is constant throughout the year at a given latitude. (LCL)

3382 (COO-3563-28) RADIOELEMENT STUDIES IN THE OCEANS. Progress Report, August 1, 1973–July 31, 1974. Bowen, V. T. (Woods Hole Oceanographic Institution, Mass. (USA)). 1974. Contract AT(11-1)-3563. 23p. Dep. NTIS $4.25.

Results are reported from studies on the distribution of fallout ^{137}Cs, ^{90}Sr, ^{239}Pu, and ^{240}Pu in Atlantic Ocean waters sampled at various locations. These radionuclides were also used as tracers for studies of upwelling in Gulf Stream rings. Samples of plankton, algae, fishes, marine invertebrates, and birds were analyzed for ^{239}Pu and ^{240}Pu content, and sediment cores from various locations were analyzed for ^{137}Cs, ^{239}Pu, ^{240}Pu, and ^{241}Am. (CH)

3383 (UCRL–51612) TRANSURANICS AT PACIFIC ATOLLS. I. Concentrations in the Waters at Enewetak and Bikini. Noshkin, V. E.; Wong, K. M.; Eagle, R. J.; Gatrousis, C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Jun 1974. Contract W-7405-eng-48. 32p. Dep. NTIS $4.00.

Available results on the concentrations and distributions of ^{239,240}Pu and other transuranic radionuclides in the lagoon waters of Enewetak and Bikini Atolls are presented. The data are derived from a series of samples collected during the period October to December 1972. The samples are being radiochemically processed and analyzed for specific radionuclides; the available results for ^{90}Sr, ^{137}Cs, ^{237}Np, ^{238}Pu ^{239,240}Pu, ^{241}Pu, and ^{241}Am in specific water samples are presented and discussed. The two Pacific atolls, sites of nuclear testing series in the 1940s and 1950s, act as sources of radionuclides, contributing quantities greatly exceeding the fallout deposition to the lagoon marine environments. The distributions of plutonium in the two lagoons are very heterogeneous; strong concentration gradients are evident in both lagoons, and the horizontal stratifications define areas of water renewal. The concentrations are affected by wave-driven water transported across the reefs and by flow through the main channels. Three to 90% of the ^{239,240}Pu in Bikini lagoon is associated with a particulate phase. ^{239,240}Pu concentrations associated with bottom particulates generally exceed the surface levels, suggesting that resuspension of fine material is an active mechanism for redistributing some plutonium throughout the lagoon. In the soluble phase, however, surface plutonium concentrations generally exceed bottom concentrations, indicating slow vertical mixing in the water column, and suggesting (1) that plutonium is derived from several sources, and (2) that surface and bottom currents independently redistribute different forms of the radionuclide to different areas of the lagoon. The ^{239,240}Pu/^{137}Cs ratios in the surface waters are not constant, indicating that different sources or mechanisms govern the redistribution of specific radionuclides in the water column of the lagoon. (auth)

3384 RADIUM-226, RADON-222, AND LEAD-210 IN BATH THERMAL SPRINGS COMPARED WITH SOME ENVIRONMENTAL WATERS. Andrews, J. N.; Wood, D. F. (Univ. of Bath, Eng.). Health Phys.; 27: No. 3, 307-310(Sep 1974).

Determination of the radium content of water from the Bath (UK) Thermal Spring are tabulated, the levels being about 100 times greater than those of other ground water sources in the vicinity of Bath. The high radium content and temperature of the thermal waters is indicative of a much longer residence time in geological strata probably at great depth, than for the meteoric ground waters. It is therefore very likely that the water has had the observed high ^{222}Rn content for a long period of time in the natural reservoir supported by continuous radon release and that ^{210}Pb would have equilibrated with such radon. The ^{210}Pb content of the water was determined and compared with the ^{222}Rn content of the water to establish whether or not radon supported ^{210}Pb had been produced. The ^{210}Pb content was found to be much less than that which would be produced by decay of supported ^{222}Rn in the natural reservoir and less than would be released by chemical leaching of the ^{210}Pb in equilibrium with the ^{226}Ra acquired by the water. It is concluded that the Bath thermal waters have circulated at great depth with a very long circulation time and that lead isotopes have been removed by wall rock interaction during ascent of the water. (UK)

3385 ^{210}Pb AND ^{226}Ra IN BOTTOM DEPOSITS OF FRESHWATER BASINS. Vilenskii, V. D.; Anikiev, V. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 8, 1259-1263(Aug 1974). (In Russian).

Data on the amounts of the subject nuclides in sediments of rivers and lakes are tabulated, and profiles of their vertical distributions are shown. (MG)

Ecosystems and Food Cycles

Refer also to abstracts 3313, 3407, 3699, 3764, and 5419.

3386 (AD-778379) PRESENT-DAY STUDIES OF THE PHYSIOCOCHEMICAL STATE OF RADIOISOTOPES IN SEA WATER. Translated from At. Energ. (USSR); 34: No. 5, 409-410(1973). 8p. NTIS $4.00.

The following topics are discussed: theoretical problems of the behavior of chemical elements in solution in trace concentrations; methods of studying the physiocochemical state of trace quantities of elements in sea water; results of observations of the state and chemical form of artificial radioisotopes and stable elements in sea water; and effect of the forms and state of radioisotopes on their interaction with living organisms of marine environments. The basic problems of methods for indicating various physicochemical forms of matter in highly diluted solution were the central topics on the agenda. (GRA)

3387 (EUR-5167e) CONTAMINATION OF FRESHWATER BY ^{54}Mn AND ^{60}Co. Nicolas, C.; Kirchmann, R. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Sep 1974. 36p. Dep. NTIS (US Sales Only) $5.00. EUR B. Fr. 50.-.

The ^{60}Co and ^{54}Mn contamination of minnows, an inhabitant of the Meuse which receives radioactive wastes from nuclear power plants, was investigated. Both radioisotopes enter rapidly in live fish. Maximum ^{60}Co and ^{54}Mn concentrations in fish are reached within a few days after fish-radioisotope contact. Fed fish accumulate more ^{54}Mn and more ^{60}Co, and faster, than starving ones. Decontamination follows several components. The ^{54}Mn and ^{60}Co take-up by dead fish is tenfold that by live ones. Dead fish contamination curve is more regular than that for live ones. Furthermore, no peak of activity is registered during a 16 day contamination period. (FR)

3388 (NP-20219) VALUES OF ^{90}Sr IN VERTEBRAE AND FEMORAL DIAPHYSES OF ADULTS IN CZECHOSLOVAKIA IN 1971. Brezik, Z.; Brezikova, D. (Institut Hygieny a Epidemiologie, Prague (Czechoslovakia)). [nd]. 8p. Dep. NTIS (US Sales Only) $4.00.

Data are presented on the content of fallout ^{90}Sr in samples of human bones collected in Czechoslovakia during 1971 and the first quarter of 1972. Samples of vertebrae and humerus from males and females aged 32 to 65 were analyzed. (CH)

3389 (NP-20220) VALUES OF THE RATIO ^{90}Sr IN VERTEBRA/^{90}Sr IN DIAPHYSIS IN DIFFERENT AGE GROUPS (CZECHOSLOVAKIA 1969, 1970, 1971). Brezik, Z.; Brezikova, D. (Institut Hygieny a Epidemiologie, Prague (Czechoslovakia)). [nd]. 6p. Dep. NTIS (US Sales Only) $4.00.

The activities of fallout ^{90}Sr (related to calcium) in samples of vertebrae and femoral diaphyses from inhabitants of Prague and middle Bohemia, aged 0 to 60, deceased in 1970 and 1971. The results of determinations are presented. (CH)

3390 (UCLA-12-973) FEASIBILITY AND ALTERNATE PROCEDURES FOR DECONTAMINATION AND POST TREATMENT MANAGEMENT OF Pu-CONTAMINATED AREAS IN NEVADA. Wallace, A.; Romney, E. M. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). Sep 1974. Contract AT(04-1)-Gen-12. 90p. Dep. NTIS $5.45.

This report was prepared in response to needs for determining the feasibility and environmental impact of cleaning up Pu-contaminated areas in Nevada. Instead of considering all aspects of radioactive decontamination, it deals primarily with findings from pertinent land area decontamination and post-management experiences that can be applied to solving Pu problems at the Nevada Test Site and the Tonopah Test Range. Previous experiences from accidental and planned releases of Pu in the environment are discussed along with those gained from nuclear fallout decontamination studies. Considerable attention is given to problems concerning revegetation of arid lands. The fragile nature of the desert is such that any drastic alteration will result in a seriously damaged ecosystem. Revegetation by natural means is difficult, if not impossible, from a practical point of view. Post-treatment management of disturbed areas is almost always necessary to insure recovery. Correction of the damage may require greater efforts than the decontamination, and may have more far-reaching consequences than those concerned with the present status of the land. Alternate procedures are discussed which may be useful in Nevada, providing the necessary experimental work is done to test the validity of the assumptions made. Many answers to pertinent questions can be obtained from investigations conducted outside of the Pu areas. Recommendations are made for experimental work that should be done to determine the best course of action before cleanup begins. (auth)

3391 IODINE INVESTIGATIONS IN NORWAY. Mathisen, O. (Forsvarets Forskningsinstituut, Kjeller, Norway). Sanitets Nytt; 20: No. 1, 31–37(Mar 1974). (In Norwegian).

In the past two years measurements have been made by the Norwegian Defence Research Institute of stable iodine in milk, drinking water, precipitation and urine. These measurements are to be seen in connection with previous measurements of ^{131}I in radioactive fallout, carried out since 1956. Radioactive iodine competes with stable iodine for uptake by the thyroid and mapping of the iodine situation in Norway is therefore of importance in facilitating rapid prophylactic measures in a critical situation. Milk would form the most important source of radioactive iodine, and measurements of iodine in milk have been made in twelve places during the summer of 1971 and the winter 1971–1972. The iodine content shows a marked increase at the end of September, presumably due to addition of seaweed to fodder. During the summer nitrogenous fertilizers and goitrogene plants can lead to a reduced iodine uptake. Drinking water analyses show low iodine contents without the expected difference between coastal and inland locations. Iodine in precipitation is of the same level as in drinking water, neither of these studies is concluded. The object of the urine measurements has been to establish the iodine status of the population, and they show satisfactory result. Many factors involving iodine are little known and these problems are being further studied at the Norwegian Defence Research Institute. (NO)

Radiometric Techniques

Refer also to abstracts 2842, 2843, 3319, 3320, 3370, and 3375.

3392 (EGG-1183-1622) WATER EQUIVALENT OF SNOW DATA FROM AIRBORNE GAMMA RADIATION SURVEYS: INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES. Burson, Z. G.; Fritzsche, A. E. (EG and G, Inc., Las Vegas, Nev. (USA)). 17 Dec 1973. 60p. Dep. NTIS $6.00.

Areal determinations of the water equivalent of snow in the Lake Ontario drainage basin in New York State were made from an airborne platform as part of the International Field Year for the Great Lakes (IFYGL) program. About 350 line miles representing the area surrounding Rochester and Syracuse, New York, were surveyed during the fall and winter of 1973. The attenuation by the snow cover of the natural gamma radiation from the soil served as the measurement technique. This method requires surveys both before and after snow covers the ground in order to observe the attenuation of the gamma intensity. Separate measurements of the total photon flux and two specific energy components (2.6 MeV from the ^{208}Tl and 1.46 MeV from the ^{40}K photopeak areas) comprise three water equivalent determinations for each survey line. Results of the airborne areal water equivalent determinations are listed in Tables A, B, and C. Table A indicates the comparison of the net count, ^{40}K peak area and ^{208}Tl peak area with snow tube measurements on the ground. These represent the three survey lines (calibration lines) for which ground based snow tube and soil moisture data were obtained. The error values represent uncertainties in soil moisture effects and sampling statistics. Table B lists the net count areal water equivalent determinations for the calibration lines on a mile-by-mile basis. The mile-by-mile determination is possible only with net count because of its relatively high signal strength compared to that of the ^{40}K and ^{208}Tl peak areas (energy components). Table C lists the areal water equivalent determinations for the rest of the IFYGL lines. These lines had little or no ground based snow tube or soil sample data to support the airborne data. These water equivalent determinations have been corrected for the expected effects of soil moisture, and the error indications (± one standard deviation) reflect the uncertainty in the soil moisture effect and other system errors. Table C, then, is the water equivalent determinations representative of a large watershed where some ground data such as snow tube and soil moisture data in one area are used to interpret airborne data in adjacent areas. (auth)

3393 (EGG-1183-1623) AIRBORNE GAMMA RADIATION SURVEYS FOR SNOW WATER-EQUIVALENT RESEARCH: PROGRESS REPORT, 1973. Fritzsche, A. E.; Burson, Z. G. (EG and G, Inc., Las Vegas, Nev. (USA)). 28 Dec 1973. Contract AT(29-1)-1183. 54p. Dep. NTIS $5.75.

The areal average of water equivalent of snow cover was measured by airborne surveys of natural terrestrial gamma radiation for 28 survey lines in the Lake Ontario Basin as a part of the International Field Year for the Great Lakes. Measurements over selected calibration lines compared well with ground-based data. Errors (±0.9 to 1.3 cm) from airborne measurements in the results represent uncertainties in soil moisture effects, sampling statistics and airborne radioactivity contributions. Examination of methods to account for airborne radon daughter contributions concentrated on dual-detector systems in which one detector preferentially "looked" up. Such systems can be used to separate the airborne radioactivity, but the accuracy of the resulting ground component is limited to about ±4%. This is caused partly by the many constituents making up the dual detector equation and partly by uncertainties in the vertical distribution of radon daughters. A 4% error in the gamma data produces a 0.7 cm error in the water equivalent. Since at least half of the weight allotment must be dedicated to the shield and additional detectors, and because of the difficulty of obtaining precise values of all constants, an unshielded detector system is recommended at this time for airborne surveys of the water equivalent of snow cover, rather than a dual-detector system. (auth)

3394 (UCB-34-P32-PR9) ISOTOPIC STUDIES ON RARE GASES IN TERRESTRIAL SAMPLES AND IN NATURAL NUCLEOSYNTHESIS. Progress Report. (California Univ., Berkeley (USA). Dept. of Physics). 16 Sep 1974. Contract AT(04-3)-34. 20p. Dep. NTIS $4.00.

Research progress is reported on K–Ar dating of rocks, time evolution of the atmospheric ^{40}Ar–^{36}Ar ratio, geochronology projects, rare gases in carbonaceous chondrites, rare earth measurements on standard samples, instrumentation, and nucleosynthesis in meteorites. (MCG)

3395 DETERMINATION OF OIL—WATER INTERFACE USING A 6 TO 8 MeV ELECTRON BEAM. Dorosh, M. M.; Parlag, A. M.; Shkoda-Ul'yanov, V. A.; Danilich, I. I.; Mazur, V. M.; Urgin, A. Yu. Sov. At. Energy (Engl. Transl.); 34: No. 6, 594–596(Jun 1973).

Translated from At. Energ. (USSR); 34: No. 6, 485–487(Jun 1973).

Oil-bearing strata differ from water-bearing strata in ^{13}C content. The deuterium content in oil strata exceeds by 50% or more the deuterium content in water strata. Hence a larger yield of photoneutrons is expected from an oil-bearing stratum, especially since the yield of photoneutrons from the ^{17}O(γ,n)^{16}O reaction turns out to be significant. In order to model an encased borehole, measurements were taken on the following mixtures: 70% SiO_2 + 30% H_2O (water-bearing stratum) and 70% SiO_2 + 30% oil (oil-bearing stratum), and also on pure water and oil (ratio of components are given in vol %). The mixtures were placed in a metal tank 42 × 42 × 42 cm. The bremsstrahlung radiation struck the tank from a side covered with 3 cm concrete (2.4 g/cm^3 density) and an iron sheet 8 mm thick to imitate the steel tube and cement collar. The photoneutrons were registered on a BF_3 counter which was in the field of scattering of the 6.5 to 8.6 MeV gamma radiation at a distance of 20 cm from the beam axis. With 8.1 MeV gamma rays the neutron yield from the oil-bearing layer exceeded the neutron yield from the water-bearing layer by ~50% for an uncased borehole, and by ~30% for a simulated cased borehole. (SJR)

3396 TOTAL FUSION ^{40}Ar/^{39}Ar AGES USING HIFAR REACTOR. McDougall, I.; Roksandic, Z. J. Geol. Soc. Aust.; 21: 81–89(Mar 1974).

Total fusion ^{40}Ar/^{39}Ar ages were determined on 22 samples, including biotite, muscovite, sanidine, hornblende, plagioclase, pyroxene, and whole rock samples of volcanics. The samples have conventional K–Ar ages ranging from 14 to 2000 m.y. The neutron irradiations for the ^{40}Ar/^{39}Ar dating were made in the HIFAR reactor, using the standard biotite GA1550 as the flux monitor. The ^{40}Ar/^{39}Ar total fusion ages of 14 samples agree to within 2% with the conventional isotope dilution K–Ar ages. The remaining 8 give measured ^{40}Ar/^{39}Ar ages from 3 to 9.5% greater than the conventional K–Ar ages. These systematic discrepancies are due to significant neutron flux gradients in the reactor that become apparent because larger amounts of samples, compared with the amount of flux monitor, were used in these cases. With samples laid out in the reactor can as in the present study the precision of the ^{40}Ar/^{39}Ar ages is about 2% (standard deviation) in the ideal case. Correction factors for interfering argon isotopes in HIFAR have been determined: $(^{39}Ar/^{37}Ar)_{Ca} = 7.44\ (\pm 0.24) \times 10^{-4}$; $(^{36}Ar/^{37}Ar)_{Ca} = 3.05\ (\pm 0.10) \times 10^{-4}$; $(^{40}Ar/^{39}Ar)_K = 0.28 \pm 0.03$. (auth)

3397 ^{40}Ar/^{39}Ar METHOD OF K–Ar AGE DETERMINATION OF ROCKS USING HIFAR REACTOR. McDougall, I. (Australian National Univ., Canberra). At. Energy Aust.; No. 3, 9–18(Jul 1974).

The principles of the ^{40}Ar/^{39}Ar isotopic dating method in rocks using the HIFAR reactor is described. Characteristics about the HIFAR reactor were obtained and it was shown that the reactor can be successfully utilized in the determination of the age of geologic materials by the ^{40}Ar/^{39}Ar method. Applications and advantages of this method, and correlations for interfering isotopes are described. (AT)

3398 ISOTOPE TECHNIQUES IN HYDROLOGY. Neumaier, F. (Institut fuer Radiohydrometrie, Munich). pp 228-238 of Umweltschutz bei nuklearer und konventioneller energiegewinnung. Braun, H. (ed.). Stuttgart; Geog Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

The mechanism for the movement of water on and in the earth is summarized. The advantages of the use of radioisotopes in the study of the movement of surface and underground waters are outlined. Specific applications of radioisotopes and isotope techniques in hydrological studies are given as examples of their wide applicability. (JSR)

3399 ISOTOPE STUDIES AND GEOCHRONOLOGY. York, D. Can. Geophys. Bull.; 25: 249-262(Dec 1972).

The research programs in isotope studies and geochronology at eight Canadian universities are described. (CA)

3400 POSSIBLE CARBON-14 ENRICHMENT IN HIGH ALTITUDE WOOD. Harkness, D. D.; Burleigh, R. (Scottish Research Reactor Centre, East Kilbride). Archaeometry; 16: No. 2, 121-127(Jul 1974).

It has been suggested that utilization of the bristlecone pine calibration for ^{14}C age correction can result in dates which are up to several hundred years too early in comparison with archaeological evidence. Among other possible causes in situ production of ^{14}C due to the high altitude growth region of the bristlecone pine has been proposed to explain this effect. Although theoretical evaluation indicates that a significant amount of ^{14}C could be produced by this mechanism, irradiation of bristlecone pine wood with a neutron dose equivalent to the calculated cosmic ray maximum received by a 6000-year-old tree did not produce any detectable effect. Other geochemical considerations related to the growth environment of these trees may offer a possible explanation for enhanced ^{14}C levels. These inherent uncertainties in the ^{14}C record of the bristlecone pine emphasize the need for an alternative source of tree-rings for comparative correlation with the ^{14}C time-scale. (auth)

3401 URANIUM VARIATIONS IN A DATED FOSSIL BONE SERIES FROM OLDUVAI GORGE, TANZANIA. Seitz, M. G.; Taylor, R. E. (Carnegie Institution of Washington, DC). Archaeometry; 16: No. 2, 129-135(Jul 1974).

Of twelve elements analyzed in a series of bovid teeth from the Olduvai Gorge, uranium is the only element that varies appreciably with the ages of the samples. Uranium concentrations increase at first, then decrease with increasing age, and therefore cannot be used by themselves to obtain absolute or even relative ages of the samples. A model accounting for the behavior of uranium is proposed in which uranium is absorbed in the samples during the decay of organic material and is lost after this decay ceases. If one accounts for uranium losses, the concentrations of uranium and its decay products may be used to accurately date skeletal material from the Olduvai gorge. (auth)

3402 EIGHTH INTERNATIONAL CONFERENCE ON RADIOCARBON DATING. Olsson, I. U. (Univ. of Uppsala). Geol. Foren. Stockholm Forh.; 96: No. 556, 37-44(1974).

From 8th international conference on radiocarbon dating; Lower Hutt, New Zealand (18 Oct 1972).

The pretreatment of different types of samples was discussed. Especially soil samples and organic deposits were treated in detail. The validity of soil datings is still not clear. Technical details of the bomb combustion of samples and the measurement of the activity with gas-filled proportional counters and scintillation counters containing benzene were given. The normalization of the results, using the ∂ C^{13} values of the samples, was discussed. The different pathways for the photosynthesis and the importance of the corrections were explained. The old standard—oxalic acid from the National Bureau of Standards—will still be used, but new standards were discussed, although not accepted at this time. The results will, in the first place, be calculated using the half-life 5568 years and then, in the second place, be corrected according to a calibration curve or table. The decision will be made at a later conference. New calibration tables were presented, but the conference did not favour any of them. (auth)

Site Surveys

Refer also to abstracts 3322, 3360–3362, and 3364.

3403 (ARH-1706(Suppl. 2)) CHEMICAL PROCESSING DIVISION ENVIRONMENTAL STATEMENT BOILING WASTE STORAGE TANKS. Colvin, C. A. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 23 Jul 1970. Contract AT(45-1)-2130. 9p. Dep. NTIS $4.00.

The project proposed is to provide two 1,000,000-gallon underground storage tanks for high-level boiling waste at Hanford. The location of the proposed facilities with respect to certain geographical features is discussed. The anticipated environmental impact is considered with respect to water, air, present environmental conditions, noise, animal life, and geology. (MCG)

3404 (BNWL-CC-1236) COLUMBIA RIVER HYDROGRAPH. Jaske, R. T. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 15 Jun 1967. Contract AT(45-1)-1830. 3p. Dep. NTIS $4.00.

A hydrograph is presented, based on data from plant surveys, the Corps of Engineers, and the USGS, which gives the potential upper limits of Columbia River water levels at locations from 335 to 395 miles from the mouth of the river. (LCL)

3405 (DOCKET-701432-6) WESTINGHOUSE RECYCLE FUELS PLANT. Archeological Survey of Proposed Plant Near Iva, Anderson County, South Carolina. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). 5 Jan 1973. 9 p. Dep. NTIS $4.00.

A search was made for the purpose of locating and recording evidence of human habitation and fossils, and a record search was made to determine if written records were available documenting any site of historic significance. No archaeological, historical, or paleontological sites of significance were recovered. Archaic period material was present in small quantities on some of the ridges. This consisted of items manufactured from quartz. The site was free of archaeological remains observable on the surface and free of known historical resources. (HLW)

3406 (DOCKET-701432-7) WESTINGHOUSE RECYCLE FUELS PLANT. Field Survey of East Branch, Weems, and Big Generostee Creeks, Anderson, South Carolina, June 4–7, 1973. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). June 1974. 28p. Dep. NTIS $4.50.

A field investigation of the streams associated with the Recycle Fuels Plant was conducted to establish a baseline for evaluation of environmental effects. With the exception of fecal coliform contamination, the water quality of the creeks was high. Plankton populations were insignificant. Most primary productivity occurred among the periphyton and vascular plants attached to bedrock. The benthic community was small and consisted primarily of fly larvae, caddisflies, and mayflies. Fish populations were small and consisted mostly of bottom-feeding scavengers that feed on detritus, algae, insect larvae, and other benthic material. (HLW)

3407 (PB-233322) TERRESTRIAL ECOLOGY BASELINE STUDY, TROJAN NUCLEAR PLANT, OREGON. Final Report, 1972–1973. (Portland General Electric Co., Oreg. (USA)). Mar 1974. 230p. (PGE-1007). NTIS $6.00.

For Portland General Electric Co., OR.

Factual record of the kinds, relative abundance, and behavioral characteristics of the important animals and plants living in the environs of the Trojan Nuclear Plant, Columbia County, Oregon, located near Rainier, Oregon. The study is divided into two categories: terrestrial ecology and aquatic ecology, and provides a basis for evaluating future biologic changes in relation to the operation of the nuclear facility as well as to changes that are associated with recreational use of water and land resources. (GRA)

3408 (PB-233434) CARTY WEST SITE METEOROLOGY. Report for April 1973–March 1974. (Portland General Electric Co., Oreg. (USA)). Jun 1974. 183p. (PGE-2005). NTIS $5.50.

The purpose of this report is to summarize the local and regional meteorology of the Carty West Site and its environs. Onsite measurements made with an instrumented meteorological tower during the period April 1973 to March 1974 are presented and discussed. Average and extreme values of meteorological parameters are developed and presented. Atmospheric dispersion factors used to assess the safety and environmental impact of a nuclear plant are derived. Models and results are presented on the environmental impact of the use of carty reservoir as a source of plant cooling water. The onsite meteorological measurement program is described and the overall quality of the program is quantitatively discussed. (GRA)

3409 (TID-26663) SUMMARY OF TECTONIC AND STRUCTURAL EVIDENCE FOR STRESS ORIENTATION AT THE NEVADA TEST SITE. Carr, W. J. (Geological Survey, Denver, Colo. (USA)). 1974. Contract AT(29-2)-474. 108p. Dep. NTIS $8.50.

A tectonic synthesis of the NTS (Nevada Test Site) region, when combined with seismic data and a few stress and strain measurements, suggests a tentative model for stress orientation. This model proposes that the NTS is undergoing extension in a N. 50°

W.–S. 50° E. direction coincident with the minimum principal stress direction. The model is supported by a tectonic similarity between a belt of NTS quaternary faulting and part of the Nevada–California seismic belt, for which northwest–southeast extension has been suggested; historic northeast-trending natural- and explosion-produced fractures in the NTS; the virtual absence in the NTS of northwest-trending quaternary faults; the character of north-trending faults and basin configuration in the Yucca Flat area, which suggest a component of right-lateral displacement and post-10 m.y. (million year) oblique separation of the sides of the north-trending depression; seismic evidence suggesting a north- to northwest-trending tension axis; strain measurements, which indicate episodes of northwest–southeast extension within a net northeast–southwest compression; a stress estimate based on tectonic cracking that indicates near-surface northwest–southeast-directed tension, and two stress measurements indicating an excess (tectonic) maximum principal compressive stress in a northeast–southwest direction at depths of about 1,000 feet (305 m); and enlargement of some drill holes in Yucca Flat in a northwest–southeast direction. It is inferred that the stress episode resulting in the formation of deep alluvium-filled trenches began somewhere between 10 and possibly less than 4 m.y. ago in the NTS and is currently active. In the Walker Lane of western Nevada, crystallization of plutons associated with Miocene volcanism may have increased the competency and thickness of the crust and its ability to propagate stress, thereby modulating the frequency (spacing) of basin-range faults. (auth)

3410 (UCRL-72953) DILATANCY MODEL FOR GRANODIORITE. Cherry, J. T.; Schock, R. N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Nov 1971. 19p. Dep. NTIS $4.00.

A dilatancy model is described that, when used in a Lagrangian stress-wave code, qualitatively reproduces the stress-strain behavior of granodiorite subjected to triaxial stress and uniaxial strain compression. The model allows inelastic strains (voids) to progressively develop in a zone when the stress state exceeds a predetermined limit. With tension positive, the inelastic strain is assumed to be in the direction of the maximum principal stress of the zone. Numerical and experimental comparisons of triaxial compression, uniaxial strain, and Hugoniot elastic limit data for Climax stock granodiorite are presented. These comparisons indicate that the model can be used to obtain the stress-strain relations that are appropriate for other brittle rocks subjected to a variety of loading states. (auth)

3411 (USGS-474-203) BATHYMETRY OF CANNIKIN LAKE, AMCHITKA ISLAND, ALASKA, WITH AN EVALUATION OF COMPUTER MAPPING TECHNIQUES. Amchitka-41. Gonzalez, D. D.; Wollitz, L. E.; Brethauer, G. E. (Geological Survey, Lakewood, Colo. (USA)). Oct 1974. Contract AT(29-2)–474. 50p. Dep. NTIS $5.50.

Defining the characteristics of Cannikin Lake, Amchitka Island, Alaska, was essential in determining the effect of a subsurface nuclear detonation on the hydrologic and biologic environment. A bathymetric map, the basic geometry of the lake, and the stage-area-volume relationship were derived from data produced by a sonic survey of the lake. At the lake's highest level, the maximum depth is 31 feet (9.45 metres), it has a volume of 325 acre-feet (401×10^5 cubic metres) and covers a surface area of 30 acres (12.1 hectares). A computer-mapping technique utilizing two different computer programs (WET and Calcomp GPCP) was used to evaluate the usefulness of the programs as mapping tools. The two bathymetric maps of the lake bottom produced by this method show a high degree of reliability when compared with the hand-drawn version. (auth)

3412 (WASH-1289) LEVELS OF ENVIRONMENTAL RADIOACTIVITY IN BIKINI ATOLL. McCraw, T. F. (USAEC, Washington, D. C.). [nd]. 13p. Dep. NTIS $4.00.

Radiation and radioactivity levels and the radionuclides contributing to those levels were determined for the Bikini Atoll environment through a detailed survey in April and May 1967, and by additional survey activities in 1969, 1970, and 1972. External radiation levels were found to vary considerably from island to island and from place to place on the same island. On islands more remote from testing activities such as Eneu and Bikini, the major contributor to the external γ field is ^{137}Cs. The levels on Bikini were observed to be highest in the more heavily vegetated interior and lowest along the shore where there has been more weathering. On near test islands, the major contributor to the external γ field was observed to be ^{60}Co. Quantities of scrap metal containing ^{60}Co were found on these islands. These were removed during cleanup operations in 1970. The information obtained since 1968 would not require any significant change in the estimates of potential exposures for the returning population. (auth)

Thermal Effluents

Refer also to abstract 5419.

3413 (COM-73-11582) DISPOSAL AND UTILIZATION OF WASTES FROM ENERGY PRODUCTION. A Bibliography With Abstracts. Report for 1970–May 1973. Lehmann, E. J. (National Technical Information Service, Springfield, Va. (USA)). Aug 1973. 84p. (NTIS-WIN-73-039). NTIS $20.00.

The NTISEARCH bibliography contains 78 selected abstracts of research reports retrieved using the NTIS on-line search system. The bibliography presents generalized studies concerning environmental factors of both thermal and nuclear power plants. These studies cover the abatement and control techniques for water pollution, air pollution, and solid waste. Not included are overly specific studies, biological effects, or studies not applicable to more than one plant. (auth)

3414 (COM-74-11138) ENERGY CONSERVATION AND WASTE HEAT UTILIZATION. A Bibliography with Abstracts. Report for 1964–June 1974. Lehmann, E. J. (National Technical Information Service, Springfield, Va. (USA)). Jul 1974. 147p. (NTIS-WIN-74-051). NTIS $20.00.

The bibliography contains 142 selected abstracts of research reports retrieved using the NTIS on-line search system NTISEARCH. The report is divided into two sections dealing with energy conservation. In the first, 50 reports are presented which concern all aspects of energy conservation including topics such as reducing electricity demand, conservation policies, and the reduction of heating and automotive fuel consumption. The second section covers all aspects of recovering waste heat from power plants, buildings, and industrial water. These 90 reports include studies of total energy systems, waste heat boilers, and the use of power plant waste heat for irrigation, heating, sewage treatment, and desalination. (auth)

3415 (CONF-740820-4) COMPARISON OF AERIAL INFRARED AND IN SITU THERMAL PLUME MEASUREMENT TECHNIQUES. Madding, R. P.; Tokar, J. V.; Marmer, G. J. (Argonne National Lab., Ill. (USA)). 1974. 33p. Dep. NTIS $4.75.

From symposium on the physical and biological effects on the environment of cooling systems and thermal discharges at nuclear power stations; Oslo, Norway (26 Aug 1974).

In situ and remote-sensing techniques for measuring thermal plumes are compared for five separate occasions. The remote-sensing aspect of the experiment was done by The University of Wisconsin using a DC-3 as a platform. Thermal scans were made with a Texas Instrument RS-18A scanner in the 8- to 14-μm range. The data were recorded on analog tape and later digitized. The in situ method was used by Argonne National Laboratory, employing a 5.5-m cathedral-hull fiberglass boat. Temperatures at the surface and at various depths were measured with fast response thermistor probes. The boat position was determined with a Motorola Mini-Ranger range positioning system. Comparison of the plumes from both methods indicates good agreement with respect to the general plume configuration, areas within isotherms, and centerline temperature decays. The only exception to this conclusion is found on one day, June 6, 1973, an exceptionally calm day with no waves and extremely low wind and ambient water velocities. Probable reasons for disagreement under such ambient conditions are discussed. The inherent advantages and disadvantages of each method are discussed in light of the results of the two sets of data. This includes both the data collecting and data analyzing procedures. It is concluded that judicious combination of both methods offers a better picture of thermal plumes than can be obtained by either technique alone. (auth)

3416 (EPRI-10) EFFECTS OF ENTRAINMENT OF ZOOPLANKTON AT THREE MID-ATLANTIC POWER PLANTS. Davies, R. M.; Jensen, L. D. (Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Geography and Environmental Engineering). Mar 1974. 83p. Dep. NTIS $5.45.

For Electric Power Research Inst., Palo Alto, CA.

The passage of zooplankton through power plants on Lake Norman, North Carolina, James River, Virginia, and Indian River Estuary, Delaware, was studied from June 1968 to November 1971. Live samples were collected by means of paired, time-coordinated submersible pumps, one located in the intake and one in the discharge. Additional samples were obtained from the discharge canal and receiving water. Replicate samples were taken to check the precision of the sampling method at each power plant. Zooplankton motility was found to be mutually dependent on temperature rise through the power plant and intake temperature. Duration of exposure to maximum temperature (time of travel of water through the plant) and water quality were important. At Lake Norman, zooplankton showed only minimal damage from entrainment at highest summer intake temperatures (22°C), but in the winter suffered 40 to 50% decrease in motility when temperature rise (ΔT) was increased from 11 to 20°C and travel time lengthened from 3 to 5 minutes. Motility of entrained zooplankton dropped below 50 percent at the James River when intake water temperature exceeded 22°C. Virtually no decrease in motility, except during chlorination, was observed at Indian River. Total residual chlorine above 0.5 mg/l in the discharge canals at Indian and James Rivers usually caused greater than 85 percent reduction in motility. At warmest summer discharge temperatures (above 27°C at Lake Norman, 40°C at James River, 36°C at Indian River), zooplankton were less numerous in samples from the discharge port than those from the mixing zone. Far field effects, however, were negligible. (auth)

3417 (EPRI-11) ENVIRONMENTAL RESPONSES TO THERMAL DISCHARGES FROM MARSHALL STEAM STATION, LAKE NORMAN, NORTH CAROLINA. Jensen, L. D. (Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Geography and Environmental Engineering). Apr 1974. 247p. Dep. NTIS $7.60.

For Electric Power Research Inst., Palo Alto, CA, and Duke Power Co.

Studies of thermal effects of the cooling water discharge of Duke Power Company's Marshall Steam Station on Lake Norman in North Carolina were initiated in July 1965. Work during the first three years involved the collection of physical and meteorological data for use in evaluating the thermal behavior of the lake and in developing temperature prediction techniques for similar deep, thermally stratified lakes. In 1968 the research was expanded to include biological studies of thermal effects. Since that time, the program has collected data from 18 stations on Lake Norman in the vicinity of the Marshall Steam Station, pertaining to water temperatures, various meteorological and water quality parameters, and populations of fish, plankton, and benthic invertebrates. The biological data have involved population and diversity studies in the main body of the lake, as well as in the intake and discharge covers. Studies on the effect of entrainment of planktonic organisms, and their passage through the condenser system of the power station, have also been conducted. (auth)

3418 (NTIS-PK-155) ECOLOGICAL EFFECTS OF THERMAL POLLUTION: SELECTED ABSTRACTS. Report for July 1964–January 1973. Ryerson, W. R. (National Technical Information Service, Springfield, Va. (USA)). Jan 1973. 99p. NTIS $20.00.

The bibliography contains 98 selected abstracts of research reports retrieved using the NTIS on-line bibliographic search system NTISEARCH. The abstracts include studies on mixing and dispersion of thermally enriched waters and waste heat utilization as well as ecological studies of thermal pollution. (GRA)

3419 (ORNL-EIS-74-28) THERMAL EFFECTS ON AQUATIC ORGANISMS: ANNOTATED BIBLIOGRAPHY OF THE 1973 LITERATURE. Coutant, C. C.; Pfuderer, H. A.; Collier, B. N. (comps.). (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 246p. Dep. NTIS $15.50.

A bibliography of 895 references with abstracts from the 1973 thermal effects literature is presented. The references are arranged alphabetically by first author. The following indexes are included: author, keyword, subject category, geographic location, taxon, and title (alphabetical listing of keyword-in-context of the nontrivial words in the title). (HLW)

3420 (ORNL-tr-2785) EFFECT OF POLLUTION ON THE GROWTH OF PHYTOPLANKTON IN A ZONE INFLUENCED BY THE HEATED WATER OF THE KONAKOVO THERMAL ELECTRIC POWER STATION. Devyatkin, V. G. Translated by H. S. Warren from Biol. Vnutr. Vod, Inform. Byull.; No. 17, 11-13 (1973). 5p. Dep. NTIS $4.00.

Experiments performed to determine the effects on phytoplankton of heated water discharged from the Konakovo Thermal Electric Power Plant in the USSR are described. The role of both temperature and chemical changes due to the heated effluents and domestic sewage from the plant was investigated during 1968, 1969, and 1970. No substantial influence on the growth of phytoplankton in the zone affected by the warmed water was observed. (LCL)

3421 (TID-26647) COLUMBIA RIVER THERMAL EFFECTS STUDY. Volume I. Biological Effects Studies. (Environmental Protection Agency, Washington, D. C. (USA)). Jan 1971. 95p. Dep. NTIS $7.75.

Studies on adult anadromous salmon showed that there was a tendency for the fish to cease upstream migration at temperatures of 70°F and above. The frequency of infection from fish diseases endemic to the Columbia River increases with increasing temperatures. Under conditions of nitrogen supersaturation, any temperature rise increases the chance of producing gas bubble disease. Laboratory experiments showed that water temperatures at 69.8°F or above were directly lethal to adult salmon and steelhead trout. The discharge of heated effluents was not demonstrated to have a detrimental effect on salmon spawning downstream or upon migrating adults. Diurnal temperature fluctuation within the range 42° to 65°F was of benefit to the growth and survival of eggs and fry. The optimum temperature for growth of juvenile fish changes with seasons and depends on food availability. Temperatures above 68°F were adverse for juvenile salmonids. Smelt had a lower temperature preference than salmon, and yellow perch and stickleback had a higher thermal tolerance than salmon. Studies on secondary production organisms showed that Daphnia was relatively resistant to thermal shock. Below the Hanford discharges, the maturity of the caddis fly was advanced two weeks due to a temperature increase of about 1°C. No changes in the growth pattern were observed in the Columbia River limpet. (HLW)

3422 (TID-26648) COLUMBIA RIVER THERMAL EFFECTS STUDY. Volume II. Temperature Prediction Studies. (Environmental Protection Agency, Washington, D. C. (USA)). Jan 1971. 64p. Dep. NTIS $6.25.

Studies were conducted on hydrology, meteorology, and geography of the Columbia River basin and water temperature regimes of the Columbia, Snake, and Willamette rivers. The following mathematical models were developed: deep reservoir, river-run, weakly stratified reservoirs, and estuary. Basic equations and assumptions, model verification, and data requirements are discussed for each type of model. Figures are presented to show predicted and actual temperatures in the Columbia River at six locations. (HLW)

3423 (WIS-SG-74-221) SEDIMENTATION OFF THE KEWAUNEE NUCLEAR POWER PLANT. Pezzetta, J. M. (Wisconsin Univ., Madison (USA)). Mar 1974. 69p. (COM-74-11114). NTIS $6.50.

A comparative two-year study of the nearshore sedimentary environment of Lake Michigan was undertaken to provide basic information on the physical characteristics of the lake bottom and beach zone in the vicinity of the condenser cooling water discharge flume of the Kewaunee Power Plant located near Two Creeks, Wisconsin. Wave action and wind-driven currents are the principal mechanisms by which the sediments are redistributed along the littoral zone in a general southerly direction. Monitoring of the sediment field and adjacent shoreline after the plant is in operation should indicate whether the jet flow of discharged cooling water will adversely affect the natural sedimentary processes operative in the nearshore environment. (GRA)

3424 THERMAL POLLUTION. Environmental Research in Hamaoka Nuclear Power Plant. Ono, S. (Tokyo Univ.). Kagaku (Tokyo); 44: No. 2, 110-116(Feb 1974). (In Japanese).

The efficiency of steam turbines is 40% in thermal power plants, and 33% in nuclear power plants. The rest of heat is exhausted as warm water discharge from condensers. As a result, the effect of the warm water discharge from power plants into the sea appears in the form of thermal pollution. For example, the environmental examination for Hamaoka nuclear power plant, and its condenser cooling system and the facilities of exhausting warm water are described. The estimation of warm water diffusion in the above-mentioned examination deals with the actually three dimensional diffusion as a two dimensional problem, by ignoring vertical mixing. Then, the application of the above method to shoal location such as Hamaoka is questionable. Because the nation-wide scale of thermal pollution is expanding, the effect of individual plant's warm water discharge must be made as small as possible. It is intended to emphasize that the attitude of the government toward warm water discharge problems is not satisfactory. The evaluation based on questionable examination and estimation should be amended. (JA)

3425 ENERGY PRODUCTION AND THERMAL EFFECTS. Proceedings of a Symposium held at Oak Brook, Illinois, September 1–11, 1973. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974). 194p. (CONF-7309117-).

Twenty papers were presented. A separate abstract was prepared for 19 papers. The remaining paper was on power plant efficiency. (LCL)

For abstracts of individual papers see: 3426–3444.

3426 FACTORS AFFECTING FEDERAL RESEARCH FOR THERMAL EFFECTS. Donnelly, W. H. (Library of Congress, Washington, DC). pp 4-24 of Energy Production and Thermal

Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

The prospects of a doubling in demand for electricity every ten years, if measures are not taken to damp increasing demand, and the realization that virtually two-thirds of the energy released in steam-electric powerplants is discharged to the environment as waste heat when considered in combination with the public desire to protect the environment underscore the importance of thermal effects research. The science and technology needed to assess and to control effects of waste heat certainly will depend upon present and future research. Thermal effects research as discussed here includes research and development to increase our knowledge of the biological and ecological effects of waste heat upon the waters, and also that intended to provide technologies for control and dissipation of that heat within conditions acceptable to society. Some of the factors that have affected, or seem likely to affect the funding and doing of thermal effects research are identified, particularly those factors that have or are likely to influence the environment for future decisions affecting the scope, direction and levels of future thermal effects research. Included among these landmarks are reports of scientific and other advisory groups, laws, executive actions, and judicial decisions. The meaning of these landmarks for the future of thermal effects research is contemplated. (auth)

3427 AEC PROGRAMS AND APPROACHES TO ENVIRONMENTAL THERMAL RESEARCH. Swineboard, J. (Atomic Energy Commission, Washington, DC). pp 25-27 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

US AEC programs and approaches to environmental thermal research are reviewed beginning with temperature monitoring in the Columbia River in the early 1940s. These programs have concentrated on evaluating the effects of power plant cooling systems on surface waters and involve three types of research: research on the thermal effects on individual aquatic organisms; research on populations; and research on aquatic communities, ecosystems and regional problems. Each of these programs is discussed, and the necessity for the future development of an environmentally sound waste heat management strategy is emphasized. (LCL)

3428 THERMAL POLLUTION INFLUENCE ON THE AQUATIC ECOSYSTEM. Jankowski, J. C. (Calumet Coll., East Chicago, IN). pp 28-31 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

Past research on the effects of power plant heated effluents on aquatic ecosystems are reviewed, the effects of water temperature increases on specific fish species in inland waters and in ocean water impoundments are described, and future research needed to assess the harmful effects of warm water effluents on the aquatic system and man is discussed. (LCL)

3429 SOCIAL RESPONSIBILITY IN THERMAL POLLUTION. ARE COOLING TOWERS THE BEST AVAILABLE TECHNOLOGY. Parker, F. L. (Vanderbilt Univ., Nashville). pp 32-38 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

The environmental, economic, technical, esthetic, and other benefits of methods of cooling nuclear power plants are weighed against environmental costs using data and impact statement information for the Browns Ferry, Palisades, and Quad Cities power plants. From these data it is concluded that the cost of the cooling towers at Browns Ferry is not justified in terms of the benefits to be obtained, that said costs would exceed estimated benefits by $54,000,000, and that the environmental impact of the cooling towers have been shown to be more harmful than once-through cooling. Therefore, opposition to cooling towers which, in comparison with once-through cooling, waste money and environmental resources is urged. (LCL)

3430 ECOLOGICAL STUDIES IN A COOLING RESERVOIR IN THE SOUTHEASTERN UNITED STATES. Beyers, R. J. (Savannah River Ecology Lab., Aiken, SC). pp 39-49 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

Par Pond on the Savannah River Plant receives cooling water from the P Reactor and was chosen as a lake for studying the effects of thermal effluents because the pond is unique in that it receives no drainage from agricultural land, no domestic wastes, very little industrial waste, and a minimum of plant nutrients is leached from the nutrient-poor forested land. Detailed information is presented on the effects of thermal effluents on fish, aquatic reptiles, toads, water fowl, aquatic plants, and nutrient concentrations of Par Pond. From these data it is concluded that both positive and negative aspects of the effects of thermal additions to Par Pond could be itemized, that complex responses and interactions between these responses take place in the heat-receiving waters, and that to thoroughly understand what is happening in such a lake, much effort must be expended to study these responses and interactions. (LCL)

3431 ZOOPLANKTON: THERMAL REGULATION AND STRESS. Bunting, D. L. (Univ. of Tennessee, Knoxville). pp 50-55 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

Information from published studies is presented on: the effects of changes in temperature on egg development in copepods, cladocerans, and rotifers, and on the maturation of these species; the thermal tolerance of zooplankton species; the combined effects of entrainment due to flowing thermal effluents and of temperature changes; and the effects of waste heat on the production of zooplankton. (LCL)

3432 ARTIFICIAL COOLING LAKES AS UNIQUE AQUATIC ECOSYSTEMS. Harmsworth, R. V. (Limnetics, Inc., Milwaukee). pp 56-66 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee, Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

Artificial cooling-lakes may in many circumstances be a viable and economic alternative to alternate cooling methods such as cooling towers. Artificial cooling lakes have been used in the past for multi-purpose projects including water supply, sport fisheries, parks and wildlife conservation areas. The limnological characteristics of cooling lakes are generally desirable and include the lack of eutrophication problems despite initial low water quality in some lakes, and good sport fisheries especially for top predator fish. Far more research is needed on the basic limnology of cooling lakes and also into the unique limnological features of cooling lakes. Further applied research on the development of management techniques should also be undertaken. (auth)

3433 LAKE SANGCHRIS: CASE HISTORY OF AN ILLINOIS COOLING LAKE. Juracek, E. (Commonwealth Edison Co., Chicago). pp 67-71 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

Environmental studies conducted on Lake Sangchris, a 2400 acre water reservoir in Illinois built to receive thermal effluents from the fossil-fuel Kincaid power plant, are described, and the legal controversies concerning the environmental impact of thermal effluents from the power plant are discussed. (LCL)

3434 COMPARISON OF THE THERMAL EFFECTS IN THE MISSISSIPPI RIVER FROM TWO DIFFERENT COOLING WATER DISCHARGE TECHNIQUES AT THE QUAD CITIES STATION. McDonald, D. B. (Univ. of Iowa, Iowa City); Eiler, H. O.; Bernhard, H. F.; Kowalczyk, J. pp 72-74 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

The effects on the ecology of the Mississippi River of the operation of side-jet and diffuser pipe systems for discharging thermal effluents from the Quad Cities power plant are compared. Side-jet discharge resulted in water temperature increases in the immediate vicinity of the discharge as much as 15°F above intake canal temperatures. The side-jet system was discontinued and replaced by the diffuser pipe system which resulted in virtually complete mixing of the heated effluent with the river water and water temperature rises of less than 1.5°F above ambient river temperatures. (LCL)

3435 CHALLENGE OF THE ENERGY DILEMMA. Lapp, R. E. (Quadri-Science Inc., Washington, DC). pp 75-80 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

Energy consumption for the past two decades and the impact of the fuel requirements to the year 2000 are considered. Projections for the coal-equivalent demands of U. S. energy to the year 2030 are made based on a 3% annual growth, even though the growth rate shifted to 4% in the 1960s. The U. S. total burnup of energy is approaching a level of 3 billion tons of coal per year, but the projections indicate a demand on energy resources to be 16.6 billion tons of coal equivalent for the year 2030. The charts indicate that by the end of the century domestic oil/gas, coal, and uranium demands will be about equal parts of energy, but this will leave an energy deficit of about 1.6 billion tons of coal or some 7 billion barrels of oil. An examination of the fuel mix available in the future indicates a rescue mission for nuclear energy. Either the energy consuming machines have to be changed to accept electric inputs or the nuclear generators have to be adapted to producing an acceptable fluid fuel for use in such devices as automobiles. The development of nuclear energy and its ensuing environmental impact and possible solutions are discussed. (MCW)

3436 MATCHING HEATED WASTE WATER DISCHARGES TO ENVIRONMENTAL ASSIMILATIVE CAPACITY. Cairns, J. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg). pp 81-84 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

Most aquatic ecosystems are capable of assimilating certain types of waste discharge in particular amounts and rates without significant damage to the ecosystem. However, the tolerance levels vary from system to system and within a single system seasonally or even daily. Waste discharge standards designed for national or even statewide use are likely to underprotect some ecosystems and not permit full non-degrading use of others. Dischargers should have two choices: conform to stringent general standards designed to protect ecosystems under all conditions; or develop an environmental quality control and monitoring program designed to permit use without abuse of the ecosystem. If a discharger is using a natural ecosystem as an extension of his waste treatment system then effective environmental quality control and management practices similar to those used within the industry should be employed. Inability to cope with this aspect of plant operation is as much a management failure as poor production and is beginning to be so recognized. In order to properly cope with environmental problems, industrial decision makers must be prepared to abandon several widespread habits: the use of "there is no evidence of harm" statements when these are based on ignorance and lack of meaningful evidence of any kind; adding environmental monitoring programs as an afterthought instead of incorporating them into the planning program at the outset; depending entirely on data gathered elsewhere for designing an environmental program for a specific site; viewing environmental use as a "free good" without cost. We are no longer a frontier society and all use of the environment has a price tag; waiting until a crisis arises before beginning to gather environmental data; acting as if the problems of each discharge into a drainage basin can be resolved in complete isolation from those of other discharges; and failing to support basic research and then complaining about the results of research sponsored by the Environmental Protection Agency and other governmental organizations. The academic arena functions well only when there is a diversity of views from which the soundest generally emerge as a result of a series of selection processes. A few suggestions on ecological activities which the power industry might find useful include: use an ecological generalist on your plant site selection team; carry out predictive bioassays using representative species or species of particular significance in the system into which the waste will be discharged; carry out a preoperational ecological survey using a team of chemists, ecologists, and taxonomists to establish baseline conditions before plant operation begins; develop continuously operative "in-plant" and "instream" biological early warning systems. These are designed to enable immediate corrective action when a biologically hazardous situation develops. They are no different in principle than performance monitoring systems related to plant operation; and carry out a post-operational ecological survey as soon as operations begin, whenever there is a significant change in the quality and/or quantity of waste discharges and whenever the early warning systems indicate significant damage to the ecosystem. (auth)

3437 SUBMERGED DIFFUSERS FOR COOLING WATER DISCHARGE. Jirka, G. (Massachusetts Inst. of Tech., Cambridge). pp 85-91 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

The characteristics of, flow patterns from, surface dilution predictions for, and design considerations involved with multiport diffusers used for the high velocity underwater discharge of heated effluents from power plants are described. (LCL)

3438 LARGE SCALE WATER COOLING VIA FLOATING SPRAY DEVICES. Kelley, R. B. (Richards of Rockford, Inc., Rockford, IL). pp 92-98 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

The concept of using spray devices floating on the surface of cooling ponds for cooling high flow rate thermal discharges from industrial and power generating plants is discussed in terms of the theoretical principles of spray cooling, the equipment needed, and the applicability of the method to large scale projects. (LCL)

3439 DRY COOLING TOWERS. Rossie, J. P. (R. W. Beck and Associates, Denver). pp 99-112 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

Information is presented on: the components and mode of operation of dry-type cooling towers; operating power plants which use these towers, the combined performance of dry cooling towers and steam turbine-generators; comparison of dry and evaporative cooling towers; and the economic optimization of the dry-cooling system. (LCL)

3440 NATURE'S COOLING POND: THERMAL DISCHARGES ATLANTIC GENERATING STATION. Ashworth, J. A. (Public Service Electric and Gas Co., Newark, NJ). pp 113-129 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

The designs and design alternatives for the cooling system for the Atlantic Generating Station, a nuclear power plant to be located approximately 2.8 miles off the New Jersey coast are described, and the environmental effects of the thermal effluents discharged from the plant are discussed. It is concluded that the design of intake and discharge structures for the system minimizes possible adverse environmental effects, and that the slightly warmer waters near the plant and the presence of the reef-like breakwater will produce beneficial effects. (LCL)

3441 THERMAL AQUACULTURE: POTENTIAL AND PROBLEMS. Yee, W. C. (Tennessee Valley Authority, Chattanooga). pp 139-149 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

Thermal aquaculture is a method for using heated effluents productively, but it does not significantly reduce the heat disposal problem of the power plant. Basic data show that warmwater fish growth rates could be increased by a factor of 2 to 3 by controlling the temperature of the water medium within the range of from 75 to 85°F. Yield potential can be optimized in flowing stream aquaculture employing nutritionally balanced feed and oxygenation of the water. Food conversion efficiency also improves with temperature control. With technical innovations, a significant reduction in production cost comparable to that already achieved in the chicken broiler industry could occur. Seafood consumed in the country is largely wild stock and comparatively little effort has been expended to culture fish on an intensive basis as is done with land animals. Waste heat is unlikely to be used in large scale applications until successful demonstrations have been achieved. Therefore, the short term impact of this activity on power plant siting should be small. Over the longer term, however, the possibilities for aquaculture should be considered during site selection. Site-oriented demonstration programs are needed to provide the technical data that will indicate the extent of improvement in quality and yield of culturable fish species through greater environmental control. These demonstration programs, some already in progress, will show the viability of thermal aquaculture. Thermal aquaculture will not diminish the amount of waste heat to be rejected from a power plant. During the summer, to maintain optimum growth temperatures, it may be desirable or necessary to dilute the heated discharge water with ambient temperature water. During the winter, the water temperature at many sites may not be as warm as desired. To the extent that ambient temperature water for blending purposes is available, this dilution process will reduce the temperature of the water discharged to the receiving water body. The cost of this dilution would be borne by the aquaculture operator and the power producer. Unless it is removed from the culture stream effluent, fish waste could contribute to the pollution of the receiving water by increasing the biological oxygen demand. The cost of adding a treatment plant to take care of fish wastes, particularly in the effluent of an intensive culture facility, should be considered and evaluated as part of the economics of thermal aquaculture. (auth)

3442 THERMAL DISCHARGE ABATEMENT: SOME ECONOMIC CONSIDERATIONS. Mullenbach, P. (William Blair and

Co., Chicago). pp 150-156 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

Some of the cost estimates available showing the wide differences between various methods of managing waste heat are reviewed. The effects on these estimates of such variables as fixed charges, interest rates, and transmission costs, and various trade-offs likely to be considered by private and public decision makers are illustrated. Finally, some personal observations on the implications of these data for a number of issues of public policy—including future research and development, plant siting and governmental standards for thermal discharges are presented. Only new plants are considered. No comments are made on back-fitting. (auth)

3443 HTGR GAS TURBINE AND POTENTIAL BENEFICIAL USES OF ITS REJECT HEAT. Sager, P. H. Jr. (Gulf General Atomic Co., San Diego, CA). pp 157-173 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee; Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

The HTGR gas turbine system utilizes the reactor coolant, helium, to directly drive a turbine-generator located in the primary loop. A major advantage of the system is that it not only efficiently produces power, but, by using a dry heat rejection system more economically than other nuclear power systems, it permits greater flexibility in siting the plant. Since heat from the HTGR gas turbine is rejected at substantially higher temperatures than it is with other types of nuclear power plants, the HTGR gas turbine also offers unique opportunities for the beneficial use of its reject heat. Consideration of potential uses of the reject heat from steam cycle plants has been limited to very low temperature (approximately 100°F) applications, and in order to achieve moderately high temperatures, it has been necessary to extract steam from an intermediate bleed point in the turbine, thus reducing the output of the power cycle. With the HTGR gas turbine, however, large quantities of reject heat at temperatures up to about 350°F can be obtained without degrading the power cycle performance. The availability of these higher temperatures enables consideration of a wide range of potential uses. If plant siting conditions permit, the HTGR gas turbine can be an ideal heat source for district heating and air conditioning. Utilizing the hot water to furnish heat directly to commercial, residential, and industrial customers and to supply air conditioning chillers, a single HTGR gas turbine plant could serve a city of approximately 300,000. Coupled to an 1100-MW(e) HTGR gas turbine, a desalination plant could produce about 160×10^4 gal of water per day from seawater. Using certain organic fluids, such as isobutane, propane, neobutane, propylene, and Freon-12, it is possible to operate a secondary cycle between the HTGR gas turbine reject heat process line and a low-temperature heat sink. Such a binary cycle can produce overall plant efficiencies of nearly 50% under current HTGR gas turbine conditions and well over 50% for an advanced HTGR gas turbine employing somewhat higher turbine inlet conditions. Perhaps just as important is the fact the capacity of a binary cycle HTGR gas turbine plant is increased by about 35%, with an incremental capital cost of only about $100/kW. This, of course, leads to a much lower average capital cost and thereby a much lower cost than can be achieved by alternative systems. Additional areas in which reject heat from an HTGR gas turbine can potentially be used include industrial and agricultural complexes. (auth)

3444 FUTURE USES OF MATHEMATICAL MODELS TO PREDICT ECOLOGICAL EFFECTS FROM THERMAL DISCHARGES. Bloom, S. G. (Battelle Columbus Lab., OH); Levin, A. A.; Raines, G. E. pp 174-190 of Energy Production and Thermal Effects. Gallagher, B. J. (ed.). Milwaukee, Limnetics, Inc. (1974).

From symposium on energy production and thermal effects; Oak Brook, Illinois, USA (10 Sep 1973). See CONF-7309117-.

Although the ecological response of aquatic biota is a very important factor to be considered in assessing the consequences of thermal effluents, little attention has been devoted to the development of methods to predict this response. Methods have been developed to predict temperature as a function of time and position from the outfall in a given body of water but these methods have seldom been extended to predict the accompanying ecological response. Preliminary mathematical simulations of ecosystems were undertaken (1) to indicate the possibilities of predicting the response of aquatic biota to thermal effluents, (2) to illustrate the type of information needed from ecological surveys to develop these models, and (3) to speculate on the outlook for future developments and uses of these models. Several steps required in the development of a comprehensive model are identified in this paper. Following a review of existing information of the environment of interest, a preliminary mathematical model can be formulated from the literature data and estimates of unknown parameters. This preliminary model can then be used to guide the acquisition of field and laboratory data. It is important that the data-collection programs be coordinated with the mathematical developments so that optimum use of the field efforts can be made and so that the required capabilities can be obtained. Complementary laboratory data are needed on biomass transfer rates as a function of temperature and other factors related to the effluent. With sufficient data, a comprehensive mathematical model can be developed to predict the response of biota and can be subjected to tests by field experiments. The model, thus developed and validated by field experiments, can then be used, with confidence, to predict ecological effects of thermal effluents. (auth)

3445 DISSIPATION OF HEAT FROM A THERMAL EFFLUENT. Mumford, W.; Czapski, U.; Felon, M. (New York State Univ., Albany). Water Resour. Res.; 9: No. 6, 1565-1578 (Dec 1973).

The relative magnitudes of surface cooling and lateral diffusion and advection from a thermal effluent are investigated. Data have been gathered at Nine Mile Point, east of Oswego, New York. An estimate of the energy balance of this plume is made. The effective lateral diffusion coefficient obtained from this budget is larger than most values published. Also, surface cooling is suggested to be larger than that estimated by a Dalton type formula. This suggestion is supported by an estimate of advection of sensible heat above the plume. A modification of the temperature of the air over the plume is indicated by the data, although no increase in vapor pressure is observed. However, the variance of the vapor pressure in both time and space suggests a high degree of turbulence. (auth)

Chemical Effluents

Refer also to abstracts 2754, 2875, 3311, 3319, 3331, 3365, 3366, 3381, 3413, 5399, 5419, 5427, and 5468.

3446 (BNWL-1815) CHEMICAL TOXICITY OF ELEMENTS. Dawson, G. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1974. Contract AT(45-1)-1830. 25p. Dep. NTIS $4.00.

The inherent chemical hazard of nonradioactive wastes released by the nuclear industry are reviewed to give a better understanding of those hazards which will influence the waste management process. The acceptable threshold levels are presented for 104 known elements in air and water intended for potable supply, propagation of aquatic life, and irrigation purposes. A final data point was added to indicate a limiting marine level beyond which edible species could concentrate elements to hazardous levels in their flesh. (CH)

3447 (JPRS-62022) TRANSLATIONS ON ENVIRONMENTAL QUALITY. Number 32. Translated from various journals (17 May 1974). 47p. NTIS $3.25.

Information is presented from: Yugoslavia on pollution of Danube termed worsening; Chile on national conservation awareness will be taught in course; Tunisia on varied approaches to pollution in Lake of Tunis; USSR on call for international action against ocean pollution, preservation of water resources in republics, Urals environmental protection, signing of Baltic antipollution convention, Baltic pollution convention, disposal of radioactive waste, hunting farm mismanagement in Azerbaydzhan, and chemical danger to larks in Vologodskaya Oblast. (GRA)

3448 (UCID-16209) ALPHA-NUMERIC USER'S GUIDE TO LLL ATMOSPHERIC DATA LIBRARY, EDITION 4. Duewer, W. H.; Gelinas, R. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Jan 1973. Contract W-7405-eng-48. 261p. Dep. NTIS $16.25.

This library is a collection of evaluated or estimated rate data for atmospheric reactions developed primarily for use by the various atmospheric modeling efforts at LLL. The library now contains data for most homogeneous gas phase reactions likely to play a major role in the stratosphere, and a limited set of reactions designed for the modeling of tropospheric smog. The table is organized alpha-numerically by reactants with arbitrary reaction numbers. The rate constants quoted fall into three categories: evaluated rate constants, unevaluated data, and estimated rate constants. (CH)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 3353 and 3689.

General Detectors and Monitors

Refer also to abstracts 2852, 3318, 3320, 3359, 3377, 3754, 4077, and 5326.

3449 (AD-780808) LOW-RANGE EXTENSION FOR THE AN/FDR-502 RADIACMETER. East, P. C.; Periard, M. A. (Defence Research Establishment, Ottawa, Ontario (Canada)). Apr 1974. 19p. (DREO-TN-74-9). NTIS $3.00.

A plug-in module and detector are described which extend the range of the AN/FDR-502 remote reading radiation monitor and alarm system from 100 MR/H down to background (10 to 15 micror/h). The detector, an 18504 Geiger-Mueller tube, is connected to the control console by a single-core screened cable which can be up to 500 feet in length. (auth)

3450 (AD-781642) TABLE FOR QUICKLY DETERMINING PLANES OF FOCUS FOR A SCINTILLATION TOMOCAMERA. Sinclair, M. D.; McManaman, V. L. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Nov 1973. 11p. (AFRRI-TN-73-19). NTIS $3.00.

Manually calculating the tomoplanes used in scintillation tomocamera procedures is not only time-consuming in a busy nuclear medicine clinic but is also subject to mathematical error. Taking these factors into consideration, a computer produced table is presented which gives tomoplane values for various geometric focal plane distances. (auth)

3451 (AED-CONF-74-151-001) ION IRRADIATION OF SOLIDS. Kalbitzer, S. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F.R. Germany)). 1974. 3p. (In German). INIS.

From workshop: basic principles and the application of ion implantation in semiconductors and other materials; Muenchen, F. R. Germany (24 Apr 1974).

4 tabs.

A brief report is given on special semiconductor detectors which have been produced by ion implantation. Surveys on the ion accelerator of the MPI nuclear physics, Heidelberg, on the layer analysis with ion scattering, on ion irradiation to change solids, and on the planned work are given in tables. (GE)

3452 (AED-CONF-74-221-003) EVALUATION OF PHYSICAL RADIATION PROTECTION: MEASURING METHODS IN PERSONNEL MONITORING. Wachsmann, F. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F.R. Germany). Inst. fuer Strahlenschutz). 1974. 9p. (In German). INIS.

From 15th annual meeting on "the authorized physician within the meaning of the radiation protection laws;" Karlsruhe, F. R. Germany (14 Jun 1974).

5 figs.; 3 tabs.

Persons occupationally exposed to ionizing radiation have to be regularly controlled for determining their personal dose, and this has to be done by two different methods independent of each other. The present paper gives an account of the measuring devices currently in use for this purpose and summarizes the advantages and disadvantages of the various methods. (GE)

3453 (CEA-CONF-2653) EXPERIMENTATION IN REACTORS WITH SELF POWERED NEUTRON DETECTORS AND MINIATURE FISSION CHAMBERS. Duchene, J.; Le Meur, R.; Verdant, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 7 May 1974. 10p. (In French). (CONF-740537-2). Dep. NTIS (US Sales Only) $4.00.

From meeting on in-core instrumentation and failed-fuel detection and location; Toronto, Canada (13 May 1974).

Many "slow" collectrons or self-powered neutron detectors with rhodium, silver, or vanadium emitters were tested. Thus, 120 vanadium collectrons are correctly operating on the EL 4 heavy water reactor. "Fast" collectrons with cobalt emitters were also tested. About 50 cobalt collectrons are still in reactors, in 60 or 300°C water. Sensitivity is dependent on emitter diameter, e.g., 0.2 and 2×10^{-22} A/n $\cdot$ $cm^{-2}s^{-1}$ per cm for 0.5 and 2 mm. During irradiation six cobalt collectrons have integrated 3×10^{21} neutrons cm^{-2} and three others 10^{22} neutrons cm^{-2}. Other studies concern 6 mm diameter miniature fission chambers. They were tested in pulsed operation up to 600°C with 10^{19} neutrons cm^{-2}. A slow response chamber was operated up to 600°C. Two fast response chambers filled with an argon-nitrogen mixture became slow during irradiation, but operated up to 600°C. Another chamber of 4.7 mm diameter was filled with argon for use in the core of a pressurized water reactor. Results of tests at 320°C and 10^{11} to $10^{14} n \cdot cm^{-2}s^{-1}$ were very satisfactory. (auth)

3454 (CEA-CONF-2670) SYSTEM FOR PERMANENT CONTROL OF α ATMOSPHERIC CONTAMINATION IN INDUSTRIAL LABORATORIES. Chaud, A.; Grandin, M.; Lamy, J. L.; Brun, J.; Lencou, G.; Da Costa Vieira, D.; Pannello, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France)). [nd]. 7p. (In French). (CONF-740523-4). Dep. NTIS (US Sales only) $4.00.

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

This paper describes the permanent control system of atmospheric contamination at the Cadarache Nuclear Center, as it has been used in the Enriched Uranium Treatment Works where it contributes both to preserve the site from any pollution and to reduce the exposure of the workers. (WHK)

3455 (HASL-287, pp 44-57) THIN-WALLED IONIZATION CHAMBER MEASUREMENTS OF COSMIC AND ENVIRONMENTAL RADIATION. Kyker, G. C. Jr.; Liboff, A. R. (Oakland Univ., Rochester, MI). Sep 1974.

From 2nd environmental radiation workshop; New York, New York, USA (20 Feb 1974).

In second workshop on the natural radiation environment (February 1974).

The construction and setup of a large-volume air-filled ionization chamber for the accurate measurement of the cosmic ray ionization intensity for precise determination of the background radiation is described. (WHK)

3456 (LA-5505-C, pp 230-236) ANISOTROPIC DETECTOR SYSTEM FOR THE MEASUREMENT OF GAMMA RAY SOURCE POSITION. Trombka, J. I.; Eller, E. L.; Vette, J. I.; Schmadebeck, R. L.; Stecker, F. W. (Goddard Space Flight Center, Greenbelt, MD). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

Studies on the detection efficiencies of cylindrical detectors for various gamma ray photon angular distributions in the energy range from 0.10 MeV to 15 MeV are described. It was found that a properly chosen cylindrical crystal can produce a significantly modulated count rate as a function of angle when rotated in an anisotropic flux. These studies further indicate that simple detector systems can be used on small satellites for the determination of a gamma ray source position. (WHK)

3457 (LA-5505-C, pp 253-259) HARD X-RAY BURST DETECTOR WITH HIGH ANGULAR RESOLUTION. Helmken, H.; Gorenstein, P.; Gursky, H. (Harvard College Observatory, Cambridge, MA). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

A detection system is described that is capable of detecting hard x-ray bursts at a rate of better than one per day at moderate balloon altitudes and that provides locations. The system can be used on long-duration flights such as super-pressure balloons or satellites and can attain resolutions down to 1 arcmin. The system consists of a random pinhole collimator and an imaging proportional counter. (MHR)

3458 (ORNL-TM-4668) IMPROVED CELLULOSE NITRATE FILM FOR THE DETECTION OF ALPHA PARTICLES. Lupica, S. B. (Oak Ridge National Lab., Tenn. (USA)). Nov 1974. Contract W-7405-eng-26. 20p. Dep. NTIS $4.00.

An improved cellulose nitrate film for the detection of alpha particles was developed. The new film is thin, durable, reproducible, and highly sensitive to alpha particle detection. A spark counting technique was used to count these detectors. In order to cast films having the desired properties, tetrahydrofuran was chosen as the carrier solvent and Di-octyl phthalate as the plasticizer and the film was cast in a dry box. The film is cemented to plastic ring mounts. After being radiated and etched in a 25% KOH solution at 40°C, the mounted film is spark counted. The background was found to be low and the response to alpha radiation linear up to 3500 counts per minute per centimeter square of film area. Several applications including radon daughter monitoring have been proposed for this film detector. (auth)

3459 (RD/B/N-2990) EVALUATION OF THE CHARACTERISTICS OF RADIATION SURVEY INSTRUMENTS. I. Assessment Techniques. Thompson, I. M. G.; Clarke, R. W.; Lavender, A.; Shipton, R. G. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). May 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

The techniques used for evaluating the performance of instruments for radiation measurement are described. The evaluation program on each type of instrument includes a radiological, electrical and environmental evaluation as well as an examination of its design features. Close liaison with operational users ensures that opinions expressed are also based upon unique practical experience. Although the evaluations are biased towards the requirements of a large nuclear power producing industry many of the features examined should be of value to all other instrument users. (auth)

3460 (WAPD-TM-1088) DELAYED NEUTRON PELLET ASSAY GAGE (LWBR DEVELOPMENT PROGRAM). Milani, S.; Emert, C. J. (Bettis Atomic Power Lab., Pittsburgh, PA (USA)). Nov 1974. Contract AT(36-1)-GEN-14. 18p. Dep. NTIS $4.00.

The delayed neutron pellet assay gage uses a nondestructive assay technique to determine the fissile content of pellets with a precision of approximately 0.1 percent. The method consists of measuring the number of delayed neutrons emitted from a fuel pellet as a result of fissions which have been induced by neutrons from two 5-milligram ^{252}Cf sources. The gage, capable of excellent precision and reproducibility, is relatively insensitive to variations in pellet length, diameter, and density. Because of self-shielding effects, the sensitivity of the gage varies with the weight percent of fissile fuel in the pellet. A typical value is 7.9×10^5 counts per gram of ^{233}U for a 2.5 w/o $^{233}UO_2-ThO_2$ pellet. The total assay time per pellet is 5 minutes or less. (auth)

3461 METHOD OF TOMOGRAPHIC IMAGING USING A MULTIPLE PINHOLE-CODED APERTURE. Chang, L. T.; Kaplan, S. N.; Macdonald, B.; Perez-Mendez, V.; Shiraishi, L. (Lawrence Berkeley Lab., CA). J. Nucl. Med.; 15: No. 11, 1063-1065(Nov 1974).

A method of obtaining tomographic images from a single exposure to the γ rays emitted by an object is described. The method uses an aperture of multiple pinholes to produce a coded shadowgram on a large-area detector. The resultant pattern must be decoded with a diffuse white light source and the original aperture to produce the image. (auth)

3462 APPLICATION OF T-CELLIT DETECTOR FOR THE STUDY OF ^{6,7}Li(p,α)^{3,4}He REACTIONS. Varnagy, M.; Csikai, J.; Szabo, J.; Szegedi, S.; Banhalmi, J. (Kossuth Lajos Tudomanyegyetem, Debrecen (Hungary). Kiserleti Fizikai Intezet). Nucl. Instrum. Methods; 119: No. 3, 451-461(1 Aug 1974).

The possibility of mass discrimination for ^{3}He and ^{4}He particles of about the same energy was investigated using a cellulose acetate (T-Cellit) solid-state nuclear-track detector (SSNTD). A method has been developed for the simultaneous determination of the angular distributions of ^{3}He and α-particles from the ^{6,7}Li(p,α)^{3,4}He reactions in the low-energy region. Preliminary results for the reaction ^{6}Li(p,α)^{3}He between 100 keV and 180 keV proton energies are also presented. (auth)

3463 MEASUREMENT OF NUCLEAR MAGNETIC MOMENTS BY PERTURBED POLARIZATION-DIRECTIONAL ANGULAR CORRELATION. Aoki, T.; Ruan, J. Z. (Rikkyo Univ., Tokyo (Japan). Dept. of Physics). Nucl. Instrum. Methods; 119: No. 3, 477-481(1 Aug 1974).

Perturbed polarization-directional angular correlation by external magnetic field proves to be useful to determine the magnetic moment of a nuclear excited state when anisotropy in the conventional directional-directional angular correlation is very small. This method has been applied to the 70 keV $5/2^+$ level in ^{177}Ta and the magnetic moment of this level has been found to be $+(4.7 \pm 0.5)\mu$N. (auth)

3464 TRIPLE CONSTANT-FRACTION DISCRIMINATOR. McDonald, W. J.; White, D. C. S. (Alberta Univ., Edmonton (Canada). Nuclear Research Centre). Nucl. Instrum. Methods; 119: No. 3, 527-532(1 Aug 1974).

An electronic circuit has been developed for use in experiments to measure subnanosecond lifetimes with coaxial Ge(Li) detectors. The circuit provides a convenient means of obtaining improved time resolution by a pulse-shape selection process. It also allows the experimenter to reject certain events which are mistimed by the electronics. (auth)

3465 IMPROVED METHOD FOR ABSOLUTE CROSS-SECTION DETERMINATIONS IN NUCLEAR REACTIONS. Schulte, K.; Kuehl, W.; Paetz, H. (Koeln Univ. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Instrum. Methods; 119: No. 3, 581-582(1 Aug 1974).

A new method for the measurement of absolute cross sections, in nuclear reactions in which more than two targets and detectors are used, is described. It consists of the determination of a best set of products of target thicknesses and detector solid angles. (auth)

3466 THE PENETRATION OF HEAVY CHARGED PARTICLES THROUGH GALLIUM ARSENIDE DETECTORS. Gupta, H. V.; Chaubey, A. K. (Aligarh Muslim Univ. (India). Dept. of Physics). Nucl. Instrum. Methods; 119: No. 3, 573-579(1 Aug 1974).

The rate of ionization energy loss and most probable energy loss in GaAs detectors have been calculated in the energy interval 5 MeV to 10 GeV for various heavy charged particles. The values of fwhm of the energy-loss distribution curve have been graphically shown for four different thicknesses of GaAs absorbers. (auth)

3467 STUDIES OF A FAST-TIMING, LARGE-DIAMETER PHOTOMULTIPLIER AS A FAST NEUTRON DETECTOR. Otsubo, T. (Tokyo Inst. of Tech. (Japan). Dept. of Physics). Nucl. Instrum. Methods; 119: No. 3, 569-572(1 Aug 1974).

Timing and n-γ pulse-shape discrimination of a neutron detector using a large-diameter photomultiplier, 60DVP, and NE213 liquid scintillator are investigated in order to study the usefulness of this system as an associated gamma-ray time-of-flight spectrometer. (auth)

3468 LIGHT-ATTENUATION EFFECTS IN THE CALCULATION OF SCINTILLATION NEUTRON-COUNTER RESPONSE FUNCTIONS AND DETECTION EFFICIENCIES. De Leo, R.; D'Erasmo, G.; Pantaleo, A.; Russo, G. (Bari Univ. (Italy). Istituto di Fisica). Nucl. Instrum. Methods; 119: No. 3, 559-567 (1 Aug 1974).

A Monte Carlo program for the evaluation of the response functions and detection efficiencies of organic scintillators for neutrons up to 15 MeV is described. With respect to previous calculations the present one takes into account, for the first time, the phenomena related to the collection of the scintillation light and the consequent attenuation caused by absorption and reflexions in the scintillator. This improvement enables the calculation to reproduce well the experimental response functions and increases the agreement between measured and calculated efficiencies even for large scintillators. A method is provided to exactly evaluate, as a function of light attenuation, the experimental bias level in electron energy units; this exact threshold value is to be used as input parameter in the calculation because it greatly influences the efficiencies to be determined. Results for a Ne213 scintillator are shown and compared with experimental values. (auth)

3469 A TRIGGER CIRCUIT, WITH NOISE REJECTION, FOR TIMING MEASUREMENTS AT LOW ENERGY WITH NaI(Tl) COUNTERS. van Zurk, R.; Lopes, F. B.; Ros, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Nucl. Instrum. Methods; 120: No. 1, 61-68(15 Aug 1974). (In French).

A trigger circuit for timing at low γ-energies with NaI(Tl) counters is described. It rejects noise pulses by selecting only the ones which have a duration greater than an adjustable value, thus permitting the lowering of its voltage threshold and consequently a true, high-efficiency first photoelectron triggering. Typical resolution times (fwhm) in a fast-slow arrangement, with a plastic scintillator on the start counter are 0.49 ns ($E\gamma = 511$ keV), 1.55 ns ($E\gamma = 32$ keV) and 2.4 ns ($E\gamma = 14$ keV). (auth)

3470 A ^{8}Be IDENTIFIER AND ITS APPLICATION TO THE (α,^{8}Be) REACTION. Wozniak, G. J.; Jelley, N. A.; Cerny, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Instrum. Methods; 120: No. 1, 29-40(15 Aug 1974).

A ^{8}Be identifier consisting of a divided collimator, a transmission (ΔE) detector and a position-sensitive E detector has been designed. A solid angle of ~ 6 msr is subtended, providing efficient detection of 35 to 70 MeV ^{8}Be events. Both a simple identifier, employing a single ΔE detector, and a modified identifier, using twin transmission detectors with subnanosecond pile-up rejection, are described in detail. On light targets ($A \leq 16$), 400 keV ^{8}Be energy resolution was obtained at a high counting rate (50 kcps). The smallest absolute cross sections observable were, at 20 kcps, 1 μb/sr c.m. (simple identifier) and, at 50 kcps, 0.1 μb/sr c.m. (modified identifier). Results from solid and gas targets are discussed. (auth)

3471 CALCULATION OF THE CURRENT OF AN IONIZATION CHAMBER EXPOSED TO A PULSED ELECTROMAGNETIC RADIATION FIELD AND COMPARISON WITH MEASUREMENTS. Dinter, H.; Tech, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Nucl. Instrum. Methods; 120: No. 1, 113-119(15 Aug 1974).

The charge concentration in an ionization chamber exposed to an electromagnetic field is calculated up to moderately high dose rates. From this the ionization current is derived for continuous radiation fields and for pulsed radiation fields with low and high repetition rates as well as for one single radiation pulse. The calculations are tested using an argon-filled chamber at pressures between 1 and 50 atm, average dose rates up to 10 rad/h and duty cycles between 2×10^{-6} and 1×10^{-4}. Without using a free parameter an agreement better than 20% on the average is achieved. (auth)

3472 BANDGAP DEPENDENCE OF THE AVERAGE ENERGY REQUIRED FOR ELECTRON-HOLE PAIR CREATION IN GaAs AND IN Si. Ryan, R. D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nucl. Instrum. Methods; 120: No. 1, 201(15 Aug 1974).

New bandgap (W_G) data for high-purity GaAs has permitted the calculation of a more accurate value of the slope $\Delta\epsilon_\alpha/\Delta W_G$ = 2.17 ± 0.05, where ϵ is the average energy required for electron-hole pair creation. (auth)

3473 A SENSITIVE METHOD FOR EARLY DETERMINATION OF THE ARTIFICIAL ACTIVITY OF AEROSOLFILTERS. Buchtela, K.; Tschurlovits, M.; Unfried, E. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Nucl. Instrum. Methods; 120: No. 1, 203-204(15 Aug 1974).

Owing to the short-lived radon daughter products, the radioactivity of the substances collected by aerosolfilter systems is considerably high immediately after the sampling period. Practically no information on artificial radioactivity of aerosols can be obtained by measurements of total (α + β)-activity because the natural activity level depends on some variables. A sensitive method for early determination of the activity of aerosolfilters with the aid of liquid-scintillation-counting and pulse-shape technique is described. (auth)

3474 A POSITION–SENSITIVE DETECTOR USING A RC NETWORK WITH QUASIDISTRIBUTED CONSTANTS. D'Amico, A.; Proca, G.A.; Renaud, J.F. (European Space Research Institute (ESRIN) of the European Space Research Organization (ESRO), 00044 Frascati, Rome, Italy). J. Appl. Phys. 45: No. 11, 5055-5059 (Nov 1974).

A simple rugged position–sensitive detector for electronic readout of charged particles analyzer is described. It consists of a terminated electrical line with almost distributed RC constants. The prototype detector consists of 560 RC groups of total length 28 mm. Techniques pertinent to printed circuits have been used. A mathematical treatment of a realistic theoretical model is presented together with preliminary experimental results. (auth)

3475 RADIONUCLIDE TOMOGRAPHIC IMAGE RECONSTRUCTION USING FOURIER TRANSFORM TECHNIQUES. Kay, D. B.; Keyes, J. W. Jr.; Simon, W. (Univ. of Rochester, NY). J. Nucl. Med.; 15: No. 11, 981-986(Nov 1974).

Transverse tomograms were generated from γ camera pictures by the implementation of a Fourier reconstruction technique. Given a set of projections of a radioactive object obtained from various angles around a central axis, it can be shown that the Fourier transforms of these projections yield a sampled representation of the Fourier transform of the activity distribution of the object. From this it is possible to reconstruct a tomogram of the object by processing and inverse transforming the sampled frequency function. Tomograms reconstructed by this technique are of high quality, demonstrating spatial accuracy and quantitative accuracy within limits imposed by internal absorption, detector resolution, and counting statistics. (auth)

3476 EXTERNAL MONITORING OF LOW ENERGY BETA-EMITTERS AND ELECTRON-CAPTURE RADIONUCLIDES. Humphreys, D. L. O. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 8, 17-20(Jul 1974).

The monitoring of radionuclides emitting low-energy beta particles, or those decaying by electron capture presents problems in the detection of the emitted radiations. Techniques for measurement of surface contamination by low-energy beta emitters in the work place (which has been linked to Maximum Permissible Doses) are discussed. Results are presented for the response of a GM tube with a thin end window, and a scintillation probe, to surfaces contaminated with ^{14}C, ^{35}S and ^{147}Pm. The direct monitoring of surface contamination by electron capture nuclides is difficult, and the poor response of most detectors to radiations from these nuclides is assessed. The special problems of direct monitoring for isotopes such as ^{3}H and ^{63}Ni are described. Relevant techniques for the monitoring of air contamination, particularly with a gaseous contaminant, are also discussed. (UK)

3477 ACCELERATOR BOUNDARY DOSES AND SKYSHINE. Jenkins, T. M. (Stanford Univ., CA). Health Phys.; 27: No. 3, 251-257(Sep 1974).

Beginning this year, AEC contractors are being required to submit dose evaluations as low as 1.7 mrem/yr to the surrounding public from their installations. This small incremental dose exists within the framework of a natural background of about 130 mrem/yr. Some of the pitfalls in estimating these small doses, especially with regard to skyshine, are discussed. It is shown that, for any accuracy at all, better data must be generated for the neutron-vs-distance curve. However, the need for measuring, or even estimating, such small doses is brought into question. (auth)

3478 AUTOMATED GAMMA RADIATION DETECTOR FOR THE DONKEY LUNG. Bohning, D. E.; Phillips, C. F.; Laurer, G.; Lippmann, M.; Albert, R. E. (New York Univ., NY). Health Phys.; 27: No. 3, 259-263(Sep 1974).

An automated external γ ray detection system has been developed to study the tracheobronchial clearance of γ-tagged aerosols inhaled by donkeys. The evolution of the new counting system and associated data processing is outlined. The detector array consists of three opposed pairs of collimated NaI(Tl) detectors mounted on a specially constructed saddle. As many as four such saddle arrays can be operated simultaneously, and the data fed into a multichannel analyzer with magnetic tape readout. Because the detector array(s) moves with the animal(s), counting errors caused by position changes are minimized. Multiple tag operation and computerized data reduction allow maximum experimental output and sophistication as well as fast and reliable data analysis. The system concept is adaptable for clearance studies in humans or other animals. (auth)

3479 CORRECTION WHEN MEASURING ^{222}Rn DAUGHTER CONCENTRATIONS BY ALPHA SPECTROSCOPY OF FILTER SAMPLES. Jonassen, N.; Hayes, E. I. (Danmarks Tekniske Hoejskole, Lyngby). Health Phys.; 27: No. 3, 310-313(Sep 1974).

When measuring ^{222}Rn short-lived daughter concentrations in aerosols by α spectroscopic analysis of ^{218}Po and ^{214}Po activity on filter samples, it is sometimes necessary to take into consideration the effect of energy degradation on the measured spectrum. When sampling with filters having good surface collection properties the correction for energy degradation is important for ^{218}Po under conditions close to radioactive equilibrium, if the sampling time is greater than 10 min or if the ^{218}Po analysis extends for more than 5 min after the end of sampling. In order to estimate the correction an extension of the analysis of the filter sample up to approximately 2 hr after the end of sampling is necessary. (UK)

3480 ANGULAR DEPENDENCE OF FAST NEUTRON FISSION TRACK REGISTRATION. Mijnheer, B. J. (Commission of the European Communities, Geel, Belgium). Int. J. Appl. Radiat. Isotop.; 25: No. 8, 337-345(Aug 1974).

The angular response of fission track detectors, consisting of a thick layer of ^{232}Th or thin layers of ^{237}Np, ^{235}U or ^{238}U, in combination with a 12 μm thick Makrofol KG foil, was measured by means of an electrical track counter for D–T neutrons and ^{252}Cf neutrons. The anisotropy T^0_{270}/T^0_{180}, the ratio of the response for perpendicular to parallel neutron irradiation, was measured in the energy range between 12.8 and 16.8 MeV. For ^{232}Th and the etching and counting conditions employed, the anisotropy of the detector response has approximately the same value as the anisotropy of fission fragment emission, which varies considerably with the neutron energy. Values for $T_{270°}/T_{180°}$ up to 1.53 ± 0.05 at 15.6 MeV have been found, compared to a value of 1.37 ± 0.04 for ^{252}Cf neutrons. For the other isotopes the observed anisotropy is also approximately 1.5. If a fission track detector is irradiated perpendicular to a neutron beam, the response can be higher if it is placed with the layer of fissile material towards the source than with the plastic layer. For thorium a maximum forward-backward effect of 1.28 ± 0.03 at 15.6 MeV has been found, whereas no effect was observed for ^{252}Cf neutrons. For the other layers of fissile materials, the effect is not as large. (auth)

3481 LOW-FLUX NEUTRON IMAGING. Swinth, K. L. (Battelle Pacific Northwest Labs., Richland, WA). Brit. J. Non-Destruct. Test.; 16: No. 5, 129-136(Sep 1974).

Judicious use of scintillation screens greatly improves the capability for low-flux neutron imaging. Room temperature and cooled ^{6}LiF-ZnS(Ag) and gadolinium oxysulfide (Gd_2O_2S: Tb) were evaluated for direct exposures, and x-ray intensifying screens were evaluated with dysprosium and europium transfer screens. Although gadolinium oxysulfide provides improved resolution, it requires seven times the imaging time of ^{6}LiF-ZnS(Ag). Studies indicate that use of intensifying screens during the transfer process decreases the flux required for a given density by about 30%

and provides contrast enhancement. It was shown that cooling of scintillator-film combinations reduces reciprocity failure effects and in these experiments decreased direct exposure times (Gd_2O_2S: Tb) by up to 80%. (auth)

3482 COMMENTS ON "TRITIUM INSTRUMENTATION FOR ENVIRONMENTAL AND OCCUPATIONAL MONITORING". A Review by Robert J. Budnitz. Maushart, R. Health Phys.; 27: No. 3, 323-324(Sep 1974).

Attention is drawn to the review article entitled "Tritium Instrumentation for Environmental and Occupational Monitoring–A Review" (Budnitz. Health Phys.; 26: 165 (1974)). Some reservations are put forward concerning the section on measurement of tritium in water with continuous flow systems in which only pure water seems to have been considered. Comment is also made on the suggested need of advances necessary to perform continuous low level monitoring of tritium in air. It is stated that proportional counter monitoring systems are commercially available which measure continuously down to 0.02 pCi/cm^3 and less. Attention is drawn to a method of measuring HTO in air by scintillation counting not mentioned in the original article, namely the freezing of the moisture on metal strips dipped in CO_2 snow or on the outside of vessels filled with that cooling agent. (UK)

3483 RADIATION IMAGING DEVICE. (to Nuclear Chicago Corp.). Netherlands Patent A7,215,098. 8 Nov 1972. Priority date 9 Nov 1971, USA. 18p. (In Dutch).

An Anger-type camera having a photomultiplier tube array mounted on the glass cover of a crystal assembly to be about one-half inch from a top surface of the scintillation crystal is described. Non-linear spatial response is measured at points on the crystal defining an array to determine correction factors at measurement points. Correction factors are stored and employed to correct output signals from the camera either on a one-event-at-a-time basis or after an uncorrected map has been stored in the core memory of a digital data system. (NL)

3484 SCINTILLATION CAMERA WITH IMPROVED RESOLUTION. (to Nuclear Chicago Corp.). Netherlands Patent A7,215,742. 21 Nov 1972. Priority Date 22 Nov 1971, USA. 26p. (In Dutch).

An Anger-type scintillation camera system fitted with a gamma ray filter between the object under study and the detector and a signal funneling type of output signal filter, in mechanical or electrical form, associated with an image recording film is described. The gamma ray filter and signal funneling type of output signal filter scan in synchronism so that the total radioactivity distribution in the object is documented on the film with improved resolution. (NL)

3485 QUENCH CORRECTION IN LIQUID SCINTILLATION COUNTING. (to Nuclear Chicago Corp.). Netherlands Patent A7,301,802. 8 Feb 1973. Priority date 10 Feb 1972, USA. 17p. (In Dutch).

A means for determining the counting efficiency of a liquid scintillation system is disclosed. Pulse amplitudes are accumulated as are the number of pulses contributing to them. The accumulated pulse amplitude sum is divided by the accumulated number of pulses to produce an average pulse amplitude for the pulses measured. The average pulse amplitude may be correlated to the average detection efficiency by an ascertainable function. Through average efficiency of detection the actual rate of radioactive disintegrations may be computed from the count rate measured. (NL)

3486 A SCINTILLATION CAMERA AND ON-LINE COMPUTER SYSTEM FOR DIAGNOSTIC APPLICATION IN NUCLEAR MEDICINE. Knopp, R.; Winkler, C. G. (Bonn Univ. (F. R. Germany). Inst. fuer Klinische und Experimentelle Nuklearmedizin). Kerntechnik; 16: No. 8/9, 372-379(Sep 1974). (In German, English).

5 figs.; 15 refs.

The Anger scintillation camera has become one of the most important diagnostic devices in nuclear medicine. Coupling of the camera to a process computer was implemented for the first time in 1966. This made it possible by the use of digital filters to increase the precision of measurement results substantially. A camera/computer system developed in Bonn offers in addition manifold possibilities of static and sequential scintigram recording and of digital processing of data matrices which can then be displayed as scintigraphic images in the optimal form for diagnostic use in clinical practice. Among the recent promising applications of the system are its use in quantitative sequential scintigraphy and in distortion-free three-dimensional scintigraphy. (auth)

3487 COMPARISON OF INTEGRAL AND DIFFERENTIAL METHODS OF LOW-LEVEL GAMMA ACTIVITY MEASUREMENTS. Chudy, M. (Komenskeho Univ., Bratislava). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; 13: 203-215(1973). (In Slovak).

The advantages of the low-level gamma activity measurements of various radioisotopes with differential and integral methods are discussed. (auth)

3488 GAS IONIZATION METHODS OF ELECTROSTATIC IMAGE FORMATION IN RADIOGRAPHY. Johns, H. E. (Ontario Cancer Inst., Toronto); Fenster, A.; Plewes, D.; Boag, J. W.; Jeffery, P. N. Brit. J. Radiol.; 47: No. 561, 519-529(Sep 1974).

The principles governing the use of an ionization chamber as an image-forming device for radiography are discussed. The proposal to use electron-avalanche amplification (Reiss, K. H., Zeitschrift für angewandte Physik, 1965, 19, 1-4) to enhance sensitivity was shown to be unsatisfactory owing to the wide range of avalanche size and the consequent "noise" in the picture. Good sensitivity and resolution could, however, be achieved by using a wide-gap chamber containing a high-z gas at a pressure of several atmospheres. Neither the range of the photoelectrons liberated nor the lateral diffusion of the ions in crossing the chamber prevented a resolution of some ten line pairs per mm from being obtained. A theoretical analysis is given first and this is confirmed by experimental pictures. (auth)

3489 POSITION DEPENDENCE OF THE RESPONSE OF Ge(Li) DETECTORS. Haas, W. E.; Hofmann, R.; Martin, J. A. (Kraftwerk Union AG, Erlangen, Ger.). Radiochem. Radioanal. Lett.; 19: No. 3, 207-216(25 Oct 1974). (In German).

According to size, construction and doping, the efficiency of Ge/Li/ detectors to γ-radiation varies with location. This effect is highly energy-dependent, i.e., local variations increase as γ energy decreases. A true-coaxial drifted detector, for example, shows differences in efficiency of up to a factor of four of the lowest value. Beyond 1 MeV most of the variations lie within a statistical margin of error. Where there is a short distance between detector and sample and where measurements of small radiation sources are involved, statistically pure results can be achieved only when the measurement positions can be repeated with a very high degree of accuracy. (auth)

3490 SOME CHARACTERISTICS OF CORONA COUNTERS. Oravets, Ya. Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; 13: 167-194(1973). (In Russian).

The experimental results of main corona-spark counter characteristics are given. (auth)

3491 TRITIUM IN NATURE. II. Experimental Equipments for Low Tritium Activity Measurements. Povinec, P.; Chudy, M.; Saro, S. (Komenskeho Univ., Bratislava). Acta Fac. Rerum. Natur. Univ. Comenianae, Phys.; 13: 277-288(1973).

Proportional counters, electronics, and an apparatus for methane synthesis are described. The minimum measurable tritium activity after 24 hours of counting is 40 TU ± 10%. The liquid scintillation method of tritium counting is described using dioxane-naphthalene-water system. Using this method activities higher than 110 TU without an enrichment can be measured. Using the electrolytic method of enrichment both methods can measure activities higher than 1 TU. (auth)

3492 SNAP-OFF CONSTANT FRACTION TIMING DISCRIMINATORS. Arbel, A. (Israel Inst. of Tech., Haifa); Klein, I.; Yarom, A. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 4, 3-8(Aug 1974).

A snap-off constant fraction timing discriminator has been designed, involving no critical adjustments and free of shape limitations. The instrument accepts both short pulses from photomultipliers (using fast or slow scintillators) and tail pulses from low-noise preamplifiers. Its performance (without rejecting events close to the detector junction) was checked with the aid of fast and slow scintillators and Ge(Li) detectors. Typical time resolutions (measured at a dynamic range of 100 : 1) were 0.41 nsec FWHM or 0.92 nsec FWTM for ^{60}Co with a pair of fast scintillators, and 3.85 nsec FWHM or 8.10 nsec FWTM for ^{22}Na with a 7% efficiency closed-end Ge(Li) detector in the stop channel. The spectral time distribution symmetry obtained is excellent. The advantages of the snap-off type over a tunnel diode, or a voltage-sensitive discriminator, for timing zero crossing signals are discussed. Experimental results are reported in detail. (auth)

3493 ANALYTICAL STUDY OF AMPLITUDE RISETIME COMPENSATED TIMING WITH GERMANIUM PLANAR DETECTORS. El-Ibiary, M. Y.; El-Kharadly, L. A. (Univ. of Oklahoma, Norman). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 4, 23-28(Aug 1974).

A method is developed for calculating the time dispersion of amplitude and risetime compensated (ARC) timing with germanium planar detectors. Universal curves for pulse shape dependent timing error and for time jitter indicate that there is an optimum ratio between the inverted and delayed pulses which leads to the best realization of a given experimental objective. Curves for the corresponding system parameters are given. It is shown that ARC timing with Ge planar detectors is always capable of giving superior performance than constant fraction timing. The work includes quantitative comparison with experimental results published elsewhere. (auth)

3494 APPLICATIONS OF THIN FILM SCINTILLATOR DETECTORS TO FISSION INVESTIGATIONS. Muga, L.; Clem, A.; Griffith, G. (Univ. of Florida, Gainesville). pp 451-460 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 2); CONF-730823-P2.

The invention and development of the thin film detector (TFD) for the detection and identification of energetic heavy ions is traced. The manner in which the elementary parameters, nuclear charge, Z, and velocity, V, of the heavy ion affect the TFD pulse-height response is described. Although in the velocity range normally encountered for fission fragments the resolution of a thin film scintillator detector is not adequate for a precise determination of individual fission fragment charge, it can be used to describe the mean nuclear charge of a group of ions previously selected as to mass; for example, mass determinations may be made by measuring the velocity (through time-of-flight techniques) and residual energy of individual fission fragments. Alternatively, the kinetic energies of complementary fission fragment pairs may be determined. In addition to these dual parameter sets, the TFD response is simultaneously recorded event-by-event. For selected mass groups, plots of TFD response versus fragment velocity may be used to derive the mean fragment charge as a function of pertinent parameters such as total kinetic energy release. This method constitutes a new experimental approach for the determination of this quantity. Errors and limitations associated with this method and possible alternative interpretations of the thin film detector response to fission fragments are discussed. (11 figures). (auth)

3495 POLARIMETER HAVING AN INCREASED EFFICIENCY. Soroka, V. I.; Mal'ko, A. I. (Inst. of Nuclear Research, Kiev). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 343-344 (1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 44-45(1974).

The construction of a double-scattering polarimeter with a ring gas target is described. The use of a ring target allows the efficiency of the polarimeter to be increased by approximately a factor of 50. The instrument is used for polarization measurements of an EG-5 accelerator. (auth)

3496 INVESTIGATION OF THE DEPENDENCE OF THE RISE TIME OF SCINTILLATIONS IN CsI ON ACTIVATOR CONCENTRATION. Lyapidevskii, V. K.; Prorvich, V. A.; Shamovskii, L. M. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 366-369(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 62-65(1974).

The one-photon method was used to investigate the kinetics of α and β scintillations in unactivated CsI crystals and in crystals activated by Tl and Na. It was shown that along with slowly growing luminescence, a fast component also exists in all the crystals (having a rise time of ~1 nsec); its intensity and spectral composition depend on the activator concentration. The nature of both components of the luminescence in the ultraviolet, yellow and blue spectral ranges is discussed. It is shown that scintillators based on CsI having a high activator concentration may be used for time analysis in the nanosecond range. (auth)

3497 METHOD FOR MEASURING THE THICKNESS OF THE SENSING LAYER OF SEMICONDUCTOR DETECTORS. Il'yasov, A. Z.; Mazitov, B. S. (Inst. of Nuclear Physics, Ulugbek, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 363-365 (1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 60-62(1974).

A method is proposed for determining the thickness of the sensing layer of semiconductor detectors, which is based on determining the energy loss by protons accelerated in a cyclotron in the sensing volume of the detector. The construction of the vacuum chamber allows the position of the detector to be changed relative to the target, and likewise for the target to be changed without disrupting the vacuum. The energy calibration of the spectrometer was accomplished by measuring the energy spectra of protons accelerated to an energy of 17.5 MeV and scattered by a target consisting of polyethylene saturated with deuterium at various angles. The proposed method allows measurement of the thickness of the sensing volumes of detectors with an accuracy of 40 to 60 μ. (auth)

3498 FISSION-FRAGMENT DETECTOR WHICH OPERATES AT LARGE LOADINGS. Zhuravlev, B. V.; Kornilov, N. V.; Sal'nikov, O. A.; Shubko, V. M. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 355-358(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 54-56(1974).

A gas scintillation counter is described which allows the recording of ~10^6 fragments per second from the spontaneous fission of ^{252}Cf for a considerable α-particle background. The efficiency with which the fragments are recorded is ~99% for a counting rate of α particles which is ≤1% of the fragment counting rate. The detector is used in a time-of-flight neutron spectrometer. The time uncertainty introduced by the gas scintillation detector is ≤4 nsec. (auth)

Radiation Dosimeters

3499 (CONF-741018-7) FIELD TESTING OF TSEE DOSIMETERS FOR PERSONNEL MONITORING. Gammage, R. B.; Cheka, J. S.; Saheli, N. (Oak Ridge National Lab., Tenn. (USA)). 1974. 7p. Dep. NTIS $4.00.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

Generally successful field tests using TSEE type dosimeters for personnel monitoring have been conducted for periods of between one day and one year and at exposures of gamma radiation ranging from essentially background level to about 100 mR/day. Performance is less satisfactory during the hottest and most humid weather of the year in Tennessee when fading is significant during three-month long exposures. Comparison with data from film, TLD and ionization chambers is satisfactory taking into account the variety of filter and absorber thicknesses used. A superior performance by the TSEE dosimeters is indicated where weaker penetrating radiations are present. The energy and angular dependence characteristics are very favorable for the purposes of X- and γ-ray dosimetry. For the task of personnel monitoring, the following have been developed: a manual reader with good reproducibility for semi-routine use, a light-proof badge, and sensitive but stable BeO ceramic dosimeters. (auth)

3500 (COO-1105-207) SENSITIVE RADIATION DOSIMETRY BY THE RITAC EFFECT. Moran, P. R.; Fullerton, G. D. (Wisconsin Univ., Madison (USA)). 1974. Contract AT(11-1)-1105. 10p. (CONF-740469-1). Dep. NTIS $4.00.

From scientific meeting of the American Association of Physicists in Medicine; Madison, Wisconsin, USA (15 Apr 1974).

A research program studying the radiation induced thermally activated current (RITAC) effect has led to a new kind of passive solid state dosimetry device. RITAC dosimeters based on high purity Al_2O_3 have fading times of years at room temperature, have extremely simple and reliable readout instrumentation, are inexpensive and reliably obtained, show intrinsic radiation sensitivities 10^2 to 10^3 greater than commercial thermoluminescence dosimeters, show linear response from sub-millirad levels to 10^2 rad, and have a useful range to more than 10^4 rad. (auth)

3501 (DPSPU-74-30-6) AUTOMATED DOSIMETRY SYSTEM. Hall, R. M.; Boiter, H. P.; Bickley, J. D.; Speed, E. C. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Plant). Jun 1974. Contract AT(07-2)-1. 12p. (CONF-740702-9). Dep. NTIS $4.00.

From Health Physics Society annual meeting; Houston, Texas, USA (7 Jul 1974).

An automated thermoluminescent dosimetry system for personnel monitoring has been in operation at the Savannah River Plant for 18 months. The system utilizes a badge (holder) containing two ^{7}LiF crystals to measure skin dose and approximate 2 cm depth dose. The badge is processed by an automated system which monitors for external surface contamination, removes the crystals from the badge, reloads the badge with annealed crystals, decodes employee identification from the badge, heats crystals with hot nitrogen gas, measures light emitted from crystals, calculates dose, and records data on a magnetic tape. The badge, crystal annealing, quality assurance, calibration-testing programs, response reproducibility, and photon and beta dose dependence are discussed. Data from the system are interrelated by means of a computerized record-keeping system which accumulates employees' radiation history for cycle, quarter, year, and Plant employment. Reports which can be used to assist in making work assignments that will maintain individual annual exposures below guides are generated. This automated system provides a total and comprehensive external dosimetry system. (auth)

3502 (IEA-329) PHYSICAL PARAMETERS OF GLOW PEAKS 4, 5 AND 6 IN TLD-100 (LiF:Mg). Blak, A. R.; Watanabe, S. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Mar 1974. 24p. Dep. NTIS (US Sales Only) $4.25.

In order to determine more precise values of the trap depth and the frequency factor of the so called peak 6 in magnesium doped LiF, produced by Harshaw Chemical Co., which is commercially known as TLD-100, an appropriate pre- as well as post-annealing treatment was used to isolate the peak 6 from the peak 5. Further post-annealing for different intervals of time at 109, 129, 140, and 145°C has shown a decay curve that can be fitted with continuous trap model, but, not with the original Randall-Wilkins model. It was found $E_6 = 1.38$ eV, $s_6 = 8.0 \times 10^{11}$ sec^{-1}. The trial to fit the observed glow curve comprising peak 4 and 5 using E- and s-values determined from decay data of each peak when isolated, and using also experimental values of peak 4 and 5 temperature, T_4 and T_5, did not reproduce the observed glow curve. By representing the experimental glow curve, around T_5, by a 6-terms polynomial function and by identifying its coefficients with corresponding coefficients in a power expansion, around T_5, of the expression $I(T) = I_4(T) + I_5(T)$, where $I_i(T)$ is Randall-Wilkins formula for peak i, more accurate values of activation energy E, frequency factors, T_4, T_5, and the ratio $n(E_4,O)/n(E_5,O)$ were determined. $n(E_i,O)$ is the density of filled traps of kind i. (auth)

3503 (NRPB-R-16) THERMOLUMINESCENT PERSONAL DOSEMETER COMPATIBLE WITH AUTOMATIC PROCESSING AND THE CENTRAL RECORDING OF DOSE HISTORIES. Casbolt, P. N.; Marshall, T. O.; Shaw, K. B. (National Radiological Protection Board, Harwell (UK)). Dec 1973. 20p. Dep. NTIS (US Sales Only) $4.25.

Factors influencing the choice of a thermoluminescent dosemeter for personnel dosimetry are discussed. The dosemeter should be economic to produce, process, and dispatch, should be convenient to use, and should provide reliable dose information. It should be suitable for automatic processing and for the central recording of dose histories. The dosemeter is required to differentiate between low-penetrating and penetrating radiation doses and a filter system has been designed for this purpose. The material chosen for the thermoluminescent dosimeter was ^{7}LiF. The low-penetrating and penetrating dose concepts are discussed, together with the problems associated with achieving this requirement. The energy response data influencing the choice of filter system are given. The plaque containing the sensitive thermoluminescent elements is designed to key into a holder. An 8 × 4 array is used for identification. The option to anneal the thermoluminescent material has been retained and the whole plaque is capable of annealing at up to 300°C. (auth)

3504 PROBLEMS OF EXPOSURE MEASUREMENT WITH EXTENDED SOURCES; CASE OF X-RAY FLUORESCENCE. Chartier, J. L.; Roman, D.; Bazoge, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service Technique d'Etudes de Protection et de Pollution Atmospherique). Nucl. Instrum. Methods; 119: No. 3, 427-444(1 Aug 1974).

A number of problems involved in the measurement of exposure rates in X-ray or gamma-ray beams from extended sources were studied. A mathematical model simulating an experimental device producing practically monoenergetic X-ray beams (X-ray fluorescence method) was developed. The theoretical results were in good agreement with experimental data previously published. From this theoretical analogy, it was possible to determine the influence of various parameters of a free-air ionization chamber, and several corrective coefficients were evaluated and measured. The experiments were performed with a mesh-grid free-air chamber especially fitted to wide beams. The results were compared with those of cavity chambers used in the same experimental conditions. (auth)

3505 ELECTRON-DOSE DISTRIBUTION AND RANGE IN VITREOUS SILICA FROM THE DILATION DETERMINED PHOTOELASTICALLY. Primak, W. (Argonne National Lab., Ill (USA)). Nucl. Instrum. Methods; 119: No. 3, 533-540(1 Aug 1974).

The radiation-induced dilatation of vitreous silica along the path of a beam of fast electrons is found to be closely a hyperbola squared. Thus, the square root of the dilatation can be extrapolated to give a terminal range; and since the dilatation depends on the 2/3 power of dose, this is equivalent to extrapolating the 1/3 power of dose. The former extrapolation is the more satisfactory because the tail of the dilatation curve is steeper. The dilatation as a function of depth (the path of the penetrating electron beam) was obtained from optical retardation measurements which had been improved to give a resolution of about 30 μm, corresponding to about 10 keV at 0.6 MeV. Data are given for 0.6 MeV electron irradiations in air and in vacuo. The effects of window and air paths are seen. The problem of voltage fluctuations is discussed and evidence of its effects is presented. (auth)

3506 THE USE OF A HOLOGRAPHIC INTERFEROMETER TO MEASURE ABSORBED ENERGY DISTRIBUTIONS IN WATER FROM PULSED ELECTRON BEAMS. Devanney, J. A. (Bureau of Radiological Health, Rockville, Md. (USA). Div. of Electronic Products). Nucl. Instrum. Methods; 120: No. 1, 77-84(15 Aug 1974).

An optical holographic interferometer was used to measure the energy deposition as a function of depth in water, as well as the total energy deposited in the water from various intensities of pulsed, monoenergetic electron beams. The energy of the electron beams varied from 1.00 MeV to 2.50 MeV in increments of 0.25 MeV. Data for 1.00, 1.75 and 2.50 MeV are presented. The interferometer and the analytical technique used to reduce the data are described. The measured results are compared to those predicted by ETRAN-15, a Monte Carlo radiation transport code. Reasonable agreement was found between the measured and the computed energy deposition in water as a function of depth of penetration of the electrons. Measured values for the total energy deposited agreed well with those predicted by ETRAN-15 and showed good correlation with the changes in the electron-flux densities. In view of the results of this study, there is no apparent reason why this technique could not be extended to measure the energy deposition of intense pulsed beams of other types of charged particles. (auth)

3507 CALCULATIONS RELATED TO THE APPLICATION OF SILICON DETECTORS IN PION RADIOBIOLOGY. Armstrong, T. W.; Chandler, K. C. (Oak Ridge National Lab., Tenn. (USA)). Nucl. Instrum. Methods; 120: No. 1, 93-105(15 Aug 1974).

Calculations have been made of the pulse-height spectrum and energy deposition in silicon detectors of various thicknesses (10, 50, 300, 1000, and 3000 μm) placed in a large region of π^- mesons stopping in tissue. The contribution of π^- captures within the detectors is determined, and the energy deposition in the detector is compared to the actual energy deposition in the tissue with the detector removed. A method for inferring the energy deposition in the tissue by various types of particles from the pulse-height spectra of the thin detectors is discussed and evaluated. (auth)

3508 DOSIMETRY WITH SOLIDS. Regulla, D. (Institut fuer Strahlenschutz, Neuherberg, Ger.). pp 285-286 of Umweltschutz bei nuklearer und konventioneller energiegewinnung. Braun, H. (ed.). Stuttgart; Geog Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

The advantages and uses of radiophotoluminescence and radiothermoluminescence detectors for dosimetry are summarized. The possibility of measurement errors in the use of these dosimeters is considered. The development of dosimeters based on exoelectron detection is discussed with respect to their possible uses. (JSR)

3509 THIMBLE CALORIMETER FOR MIXED RADIATION DOSIMETRY. Inada, T.; Sakata, S.; Hoshino, K.; Hiraoka, T. (National Inst. of Radiological Sciences, Chiba, Japan). Int. J. Appl. Radiat. Isotop.; 25: No. 8, 377-378(Aug 1974).

A calorimeter unit is described which consists of a pair of simple calorimeters, which are equivalent in size to a usual ionization chamber and can be used for determining the dose in $n + \gamma$ mixed fields of the order of 10 rad/min dose rate. Calibration of such dosemeters is considered. (UK)

3510 USE OF SOLID SUCCINIC ACID FOR DOSIMETRIC PURPOSES. Bartonicek, B.; Pejsa, R. (Ustav Jaderneho Byzk Vyzkumu, Rez, Czech.). Int. J. Radiat. Phys. Chem.; 6: No. 4, 271-274(Sep 1974).

The main gaseous product of the γ-radiolysis of solid succinic acid, CO_2, is formed with a yield of 3.65 ± 0.15. The sum of the yields (G-values) of minor gaseous products, CO and H_2, amounts to about 0.2 to 0.4. These yields are not affected by crystal size (0.06 to 2 mm), temperature (20 to 150°C) or dose rate (0.85 to 14.15 krad min^{-1}). (auth)

3511 FAST NEUTRON DETECTION BY PHOSPHOR ACTIVATION. Mayhugh, M. R.; Watanabe, S. (Instituto de Energia Atomica, Sao Paulo, Brazil). Health Phys.; 27: No. 3, 305-306 (Sep 1974).

To illustrate the feasibility of using thermoluminescent phosphors for measuring fast neutron doses in mixed fields, $CaSO_4$:Dy powder was irradiated in a swimming pool reactor. The results are given. The rate considerations shown indicate that given a certain concentration of radioactive nuclei, short half-life systems would be more sensitive in terms of the lowest detectable fluence, even though longer self-irradiation can be used in long half-life cases. For short half-lives the phosphor may not be so sensitive as to see the background during the shorter self-irradiation in which case the sensitivity would not be improved by reducing the background level. Also for short half-life products, the flux must be high enough to keep irradiation times small, or flux/time details must be known. It is concluded that TL resulting from phosphor activation is a feasible means for detecting fast neutrons. (UK)

3512 PERSONAL EXPOSURE MONITORING IN HIGH DOSE RATE RADIATION FIELDS. Hoegl, A.; Schubert, K. (Frieseke und Hoepfner G.m.b.H., Erlangen (F. R. Germany)). Kerntechnik; 16: No. 8/9, 355-359(Sep 1974). (In German, English).

It is advisable for persons exposed to radiation fields with a high gamma or x-ray dose rate to wear dose warning devices and rod dosimeters. This paper describes the practical use and technical data of a new dose warning device (FH 41 S and FH 41 F). (auth)

3513 ENERGY DEPENDENCE OF DIRECT-READING POCKET IONISATION CHAMBERS WITH RESPECT TO X-RAYS AND BETA RAYS. Burgkhardt, B.; Piesch, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Strahlenschutz und Sicherheit). Kerntechnik; 16: No. 8/9, 360-364(Sep 1974). (In German, English).

2 figs.; 5 tabs.; 6 refs.

The energy dependence of the dosimeter reading was determined on 9 types of direct-reading pocket ionisation chambers in the energy range from 10 keV to 1.2 MeV. Thin-walled chambers show above 20 keV an energy dependence of about ±15%. Investigations with beta radiation with maximum energies ranging from 0.224 to 3.6 MeV show that these chambers are less suitable for beta dosimetry even at high energies than LiF dosimeters. (auth)

3514 DOSE AND DOSE RATEMETERS: TYPES, STANDARDS, NOVELTIES. Maushart, R. (BF-Vertriebs-G.m.b.H. fuer Messtechnik, Karlsruhe (F. R. Germany)). Kerntechnik; 16: No. 8/9, 345-354(Sep 1974). (In English, German).

5 figs.; 1 tab.; 18 refs.

The stipulations and requirements of the pending calibration ordinance for measuring devices, and of the pending Standard DIN 6818 "Radiation protection dosimeters", will exert a substantial influence in the coming years on the development of dose and dose rate meters for radiation protection. This paper discusses possible repercussions of these specifications, describes the current development trends (miniaturization, digitalization, inclusion of warning functions) on the example of some recently developed German and foreign devices, and compares the performance data of these devices in respect of the energy dependence of the reading with the currently applicable requirements. This comparison shows that none of the pencil dosimeters studied satisfies the conditions for measurements in the minimum nominal energy range I (10 keV to 60 keV) laid down in the relevant PTB specifications. According to these specifications, dose rate measuring devices with GM counter tubes, extensively used at present for radiation protection measurements, also cannot be used for measurements in the minimum nominal range II (30 keV to 250 keV); their use remains limited to the minimum nominal range III (100 keV to 1.3 MeV). (auth)

3515 ABSOLUTE MEASUREMENT OF RADIATION DOSE BY THE IONOMETRIC METHOD. Rebigan, F. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 25: No. 10, 1203-1220 (1973). (In Rumanian).

The application of the principle of electronic equilibrium to the measurement of exposure and absorbed dose is given. Three types of measuring instrument, namely the free-air ionization chamber, the cavity chamber and "tissue-equivalent" ionization chamber as well as the charge measuring system are briefly described. The relationships of exposure, absorbed dose, activity and fluency are derived in detail. Corrections and errors occurring in these measurements and experimental data for ^{60}Co and ^{137}Cs sources are finally given as practical examples. (auth)

3516 APPLICATION OF SILICON DIODE INTEGRATING DETECTOR IN FAST-NEUTRON DOSIMETRY. Frank, H. (Technical Univ., Prague); Seda, J.; Trousil, J. Jad. Energ.; 20: No. 8, 258-267(Aug 1974). (In Czech).

The results of research on a fast neutron dosimeter based on the silicon diode are described. The first part of this work critically reviews the most recent knowledge of silicon fast neutron dosimeters. Both physical principles of neutron action on silicon and dosimetric parameters of several commercial silicon diodes (U. S. A., United Kingdom, Western Germany, Sweden) are summarized. The second part deals with the silicon diode calculation with the aim of finding technological parameters for production of a fast neutron dosimeter. In addition, the results of development of Czechoslovak detectors and their dosimetric properties are given. In conclusion the results which make possible the diode production are summarized and the dosimetric parameters (fading, sensitivity) which overcome the foreign commercial diodes are discussed. (auth)

3517 USE OF RADIOPHOTOLUMINESCENT DETECTORS IN THE DOSIMETRY OF IONIZING RADIATION. Kodl, O. (Radiation Hygiene Centre, Prague); Trousil, J. Jad. Energ.; 20: No. 8, 272-277(Aug 1974). (In Czech).

Measurement results of the dosimetric properties of Yokota FD-P8-3 radiophotoluminescent glasses are presented and the advantages of the use of these detectors are demonstrated. Besides a short explication of the physical foundations of the method, the experimental work was concentrated on the determination of the time and exposure dependence, measurement reproducibility, energy dependence and compensation of the RPL response and the possibilities of glass recovery. The measurement results are statistically treated and the advantages and drawbacks of the method are summarized. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 2761, 2836, 4057, and 5048.

3518 (ANL/ACEA-103) INTRODUCTION TO Ge(Li) AND NaI GAMMA-RAY DETECTORS FOR SAFEGUARDS APPLICATIONS. Kull, L. A. (Argonne National Lab., Ill. (USA)). Sep 1974. 107p. Dep. NTIS $8.50.

A brief treatment of Ge(Li) and NaI detectors for personnel involved in nuclear materials safeguards work is given. (WHK)

3519 (HMI-B-145) COMPUTER-ON-LINE SYSTEM FOR TIME-OF-FLIGHT AND ANGLE-CORRELATION EXPERIMENTS. Abend, P.; Bossel, J. B.; Butt, R. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)). Feb 1974. 59p. (In German). Dep. NTIS (US Sales Only) $6.00.

A computer-on-line instrumentation system, typical for many low-energy physics experiments, is described which, as an example, has been applied for a γ-γ-angular correlation experiment. The system is used for data acquisition from multi-detector arrays, sorting data into 24 spectra of 2 K words each, graphic presentations, preprocessing and storage, and for controlling the experiment. The system is implemented by means of a modular electronic instrumentation (CAMAC system) and a modular system of user programs which may run concurrently under a multitasking expansion of the computer operating system. (auth)

3520 (NP-20229) DEVELOPMENT AND INVESTIGATION OF MONOCRYSTALS FROM STRONGLY ABSORBING SEMICONDUCTOR MATERIALS FOR GAMMA-RAY SPECTROSCOPY (PbO, PbI_2, HgI_2). Willig, W. R. (Erlangen-Nuernberg Univ., Erlangen (F.R. Germany). Technische Fakultaet). 28 Jul 1972. 58p. (In German). INIS.

40 figs.; 79 refs. Available from the library of the Erlangen Univ.

A new detector is described which operates as a photoresistor and needs no pn-transition. In spite of the high absorption coefficient, no cooling is necessary. With the help of the HgI_2-monocrystal used, it is possible to measure gamma spectra with ten percent FWHM. (GE)

3521 (PB-233418) FAST PULSE PROCESSING FOR GAMMA-RAY SPECTROSCOPY. Report of Investigations. Fasching, G. E.; Patton, G. H. (Bureau of Mines, Morgantown, W. Va. (USA). Morgantown Energy Research Center). Apr 1974. 16p. (BM-RI-7909). NTIS $3.00.

A pulse counting system with improved energy resolution was developed having dual channels to process pulses at different rates and a pulse pileup detector for channel selection. Pulse input is delayed until the detector determines if any pulse is so closely followed by a second pulse as to constitute pulse pileup. If no pulse pileup is detected, the slower channel is selected and clips the pulse to a relatively wide pulse width to retain good energy resolution. If pulse pileup is predicted, the fast channel with correspondingly shorter pulse width is selected to improve resolution with respect to time. Output of the two channels is transmitted to a pulse height analyzer for interpretation. The pulse processing system can process count rates above 300,000 cps with little loss in energy resolution. (auth)

3522 (PB-233748) EVALUATING PLASTIC SCINTILLATORS FOR DETECTING PROMPT GAMMA RAYS IN CONTINUOUS ANALYSIS OF BULK MATERIALS. Report of Investigations. Hall, A. W.; Friggens, G. R. (Bureau of Mines, Morgantown, W. Va. (USA). Morgantown Energy Research Center). May 1974. 16p. (BM-RI-7920). NTIS $3.00.

Cylindrical plastic scintillators were investigated for efficiency in detecting neutron-induced prompt gamma rays. Scintillator performance was compared on the basis of half-resolution and peak-to-trough ratios for gamma spectra obtained from ^{60}Co (1.17 and 1.33 MeV), ^{228}Th (2.62 MeV), and PuBe (4.43 MeV). Various sizes of pilot chemical scintillators types B, F, M, and Y were tested. The best half-resolution, 7.7 percent for PuBe, was achieved with a 5-by-5-inch Pilot Y scintillator and dual photomultipliers. Comparison with sodium iodide scintillators and the use of plastic scintillators for on-stream analysis of sulfur in coal is discussed. Plastics were found to be unsuitable for on-stream analysis of materials having complex gamma ray spectra. However, they could conceivably be used for those yielding simpler spectra. (GRA)

3523 (SGAE-2322) CRYSTAL HOLDER FOR A NEUTRON SPECTROMETER. Kunsch, B.; Rupp, J.; Schwara, R.; Zagicek, S. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Inst.). Sep 1974. 24p. (In German). (PH-164/74). Dep. NTIS (US Sales Only) $4.25.

A goniometer head for the use with monochromator and analyzer single crystals on neutron spectrometers is described. As pre-oriented crystals are available, the adjustable range of the χ and ϕ angles is limited to a few degrees saving costs and making its production possible even in small workshops. Both manual and remote settings are provided. The accuracy of setting is of the order of 1′. Furthermore, a model with extended χ-range of 100° together with its electronic control in CMOS is described for the installation of a multiwave-length monochromator on spectrometers with fixed monochromator angle. Test results showing the performance are given. (auth)

3524 A NEW DETECTOR ASSEMBLY FOR CONVERSION ELECTRONS AND X-RAYS FROM MOESSBAUER EFFECT. Isozumi, Y.; Lee, D. I.; Kadar, I. (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). Nucl. Instrum. Methods; 120: No. 1, 23-28(15 Aug 1974).

A new detector assembly has been successfully designed for simultaneous ^{57}Fe Möessbauer measurements for both thin surface layers and the inside of a sample. The assembly consists of two proportional counters combined together: One is used to detect FeK X-rays emitted after the K-shell conversion process of the resonantly excited 14.4 keV level, while the other is used to detect electrons emitted by the conversion process and by the Auger effect after the process. By means of an electronic interface specially designed, signals from the electron counter and the X-ray counter are accumulated alternately in different memory groups of a multichannel analyser. (auth)

3525 A MONTE CARLO PROGRAM FOR THE CALCULATION OF GAMMA-RAY SPECTRA FOR GERMANIUM DETECTORS. Meixner, Ch. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Reaktorexperimente). Nucl. Instrum. Methods; 119: No. 3, 521-526(1 Aug 1974).

The spectra of germanium detectors may be calculated with very simplified assumptions about the interaction processes if the calculated spectra should be used as an aid for the analysis of unknown spectra. Therefore a simple Monte Carlo procedure is described to calculate the spectra of all nuclides, the energies and intensities of which are known. The limits of the procedure are pointed out. (auth)

3526 AN INTERPRETATIONAL TECHNIQUE OF SANDWICH ACTIVATION MEASUREMENTS. Bozzi, L.; Caporella, F.; Cosimi, M.; Martini, M. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). Nucl. Instrum. Methods; 119: No. 3, 599-604(1 Aug 1974).

The sandwich foil technique can be used for spectrum measurements in facilities with slowing-down neutrons. Measurements were made in the equilibrium spectrum of a large iron block after the detector calibration in a well known E^{-1} spectrum. The interpretation technique makes use of an appropriate calculation with an "ad hoc" program. A good agreement was found between the experimental and the calculated spectrum. (auth)

3527 ENERGY CALIBRATION OF A QUASI-MONOENERGETIC PHOTON BEAM WITH A Ge(Li) DIODE. Berg, U.; Kneissl, U.; Kuhl, G.; Weller, A. (Giessen Univ. (F. R. Germany). Strahlenzentrum). Nucl. Instrum. Methods; 119: No. 3, 423-425(1 Aug 1974).

As a new direct method to calibrate the energy of a beam of quasi-monoenergetic photons from positron annihilation in flight with the use of a Ge(Li) γ-spectrometer is proposed. The measurements were performed with a 100 cm^3 diode at an energy of 13.7 MeV. The results are in good agreement with the calculated photon energy and energy width. (auth)

3528 A DOUBLE-SCINTILLATOR TIME-OF-FLIGHT SPECTROMETER. Paterson, W. J.; Redfearn, J. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Nucl. Instrum. Methods; 119: No. 3, 463-475(1 Aug 1974).

A double-scintillator spectrometer has been developed to measure neutron energy distributions in the range 250 keV to 8 MeV in low-power fast reactor assemblies. The spectrometer is used in a parallel beam of neutrons emerging from each assembly operating at steady power. The spectrum of neutron energies in the beam is obtained from the measured distribution of neutron flight times between a scattering scintillator detector in the beam and a second detector outside the beam, in a position to detect neutrons scattered through 45°. The properties of the spectrometer are described, and results of measurements on two VERA reactor assemblies are compared with results obtained by other methods. The comparisons confirm that accuracies between ±5% and ±10% (68% confidence limits) can be achieved throughout the energy range. An evaluation of the spectrometer is given, relative to other methods which can be used in the same energy range. (auth)

3529 FAST CALIBRATION OF LARGE Si(Li) ELECTRON DETECTORS FROM 511.0 TO 4564.0 keV USING DOUBLE-ESCAPE PEAKS AND COMPTON EDGES FROM ^{66}Ga. Firestone, R. B.; Warner, R. A.; McHarris, W. C.; Kelly, W. H. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Nucl. Instrum. Methods; 120: No. 1, 199-200(15 Aug 1974).

Double-escape peaks and Compton edges from the γ-rays of 9.5-h ^{66}Ga have been used to allow fast, precise calibration of Si(Li) electron detectors. They allow a direct calibration up to 4564.0 keV, and the calibration curve is linear enough that it can probably be extrapolated safely to even higher energies. (auth)

3530 GAMMA SPECTROSCOPY WITH INSULATED CdS CRYSTALS. Eichinger, P. (Institut für Festkörpertechnologie der Fraunhofer—Gesellschaft, 8 München 60, Paul—Gerhardt—Allee 42, Germany); Kallmann, H. Appl. Phys. Lett. 25: No. 11, 676-677 (1 Dec 1974).

The technique of using thin insulating layers as blocking contacts has been applied to CdS crystals for γ spectroscopy. Detector operation at temperatures up to 100 °C was possible with an energy resolution of 8 keV at 122 keV for a 125—μm—thick crystal. During counting no external bias has been applied: Internal fields of the order of 10^5 V cm^{-1} can be generated if the insulator—semiconductor interfaces are charged by illumination under external bias. By comparison of the amounts of charge generated by single γ quanta in a germanium crystal and in a CdS crystal, the mean energy to create a pair has been determined to 6.3 eV for CdS. (auth)

3531 INTRODUCTION TO X-RAY SPECTROMETRY. Jenkins, R. London; Heyden (1974). 163p.

The book is intended for analysts, using x-ray methods. The subject is dealt with in chapters, entitled: introduction, x-ray spectra, physics of x-rays, instrumentation, qualitative analysis, errors in x-ray analysis, quantitative analysis, and the study of chemical bonding. (UK)

3532 CALIBRATION OF THE GAMMA SPECTROMETERS WITH SEMICONDUCTOR DETECTORS. Nistor, O. I. (Univ., Bucharest); Moisescu, B. Stud. Cercet. Fiz.; 25: No. 8, 907-917 (1973). (In Rumanian).

The GAMAETAL program is described for the computation of polynomial calibration coefficients for energy, resonance width, and for semiconductor detector efficiency depending on channel position for gamma spectra peaks recorded by a multichannel analyzer. The program is written in FORTRAN language for two variants of two analytic shapes of resonances, i.e., Gaussian and an asymmetric Gaussian shape, both superimposed on a linear background. The calibration coefficients computed from the spectra peaks are designated to another program for automatic spectra fitting which provides the physical unknown parameters of some unknown spectra, i.e., the energies and the partial activities of the gamma rays. Besides the main purpose of "calibration", the program can also do the "analysis" of the unknown spectra giving only the approximate positions of peaks of interest in channels. (auth)

3533 FIVE-CRYSTAL SPECTROMETER FOR MEASURING THE RADIATIONS FROM A HUMAN BEING. Fedorov, G. A.; Moiseev, I. F.; Konstantinov, I. E. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 370-373(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 66-68(1974).

A new method is described for recording the radiation from a human being, which ensures good uniformity of the counting efficiency when the localization of a nuclide is changed. The parameters of the spectrometer for measuring radiations from a human being are presented, which allow performance of measurements at a minimum measurable activity of 2.0 nC with a photopeak of 10%, and a count uniformity of ~18%. (auth)

3534 COMPARISON OF NUCLEAR-RADIATION DETECTORS ACCORDING TO A PERFORMANCE INDEX. Ivanov, V. B.; Lyadov, G. D.; Shipilov, V. I. (Scientific-Research Inst. of Atomic Reactors, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 359-362(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 57-60(1974).

Seven semiconductor Ge(Li) detectors and a NaI(Tl) detector having the dimensions 40 × 40 mm are investigated according to the performance index for measurement of the activity of an individual nuclide in a mixture and according to the performance index for detection of a photopeak. The methods of increasing the performance index by changing the geometric and installation parameters of the detectors are discussed. (auth)

3535 IDENTIFICATION OF HEAVY PARTICLES USING TIME-OF-FLIGHT. Gorymov, O. Yu.; Dobrikov, V. N.; Nemets, O. F.; Rudchik, A. T. (Inst. of Nuclear Research, Kiev). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 339-342 (1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 41-43(1974).

The block diagram of an installation for the identification of particles according to their masses by means of the product Et^2 is described, where E is the particle energy; t is their time-of-flight from the target to the detector. Results of identification of particles using a two-dimensional analyzer are likewise presented. (auth)

3536 DEVELOPMENT OF A TIME-OF-FLIGHT SPECTROMETER AND ITS APPLICATION TO THE REACTION ^{40}Ar(^{3}He,n)^{42}Ca. Petersen, J. F. Ann Arbor, MI; Univ. of Michigan (1974). 117p. University Microfilms Order No. 74-25,291.

Thesis (Ph. D.).

A neutron time-of-flight spectrometer was developed for use with the 83-inch cyclotron. Particular attention was paid to the requirements on beam quality imposed by this application of the cyclotron. Various modifications were made to the cyclotron to enable its successful use with the time-of-flight spectrometer. These modifications and the theoretical considerations which prompted them are described. An external ion optical system was designed to transport the extracted beam to the target area. The reaction scattering angle is variable from −10° to +80° by moving the target through a final 90° bending magnet. Target systems which allow for fast and reliable background measurements were built for both solid and gas targets. The spectrometer was used to measure the neutron time-of-flight spectrum from the (^{3}He,n) reaction on an argon gas target. The results from this reaction are discussed in the context of current theoretical descriptions of the ^{42}Ca nucleus. (Diss. Abstr. Int., B)

High Energy Physics Instrumentation

Refer also to abstracts 4066, 4067, 4569, and 4873.

3537 (CERN-74-9(Vol.1)) PROCEEDINGS OF MEETING ON TECHNOLOGY ARISING FROM HIGH-ENERGY PHYSICS, GENEVA, 24-26 APRIL 1974. Volume 1. Review Papers. Jesse, A.; Taylor, C. S. (eds.). (European Organization for Nuclear Research, Geneva (Switzerland)). 15 Jun 1974. 209p. (CONF-740449-(P1)).

Separate abstracts were prepared for the 13 papers presented. (WHK)

For abstracts of individual papers see: 3538–3540, 4054, 4055, 4065–4068, 4096, 4101, 4569, and 4570.

3538 (CERN-74-9(Vol.1), pp 19-26) ROLE OF TECHNOLOGY IN HIGH-ENERGY RESEARCH. Carreras, R. (CERN, Geneva). 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

A brief survey of the activities of CERN is presented, and examples of technological problems occurring in the performance of high-energy physics experiments are given. The main fields discussed are: acceleration, production of particles, detectors, and data handling. (auth)

3539 (CERN-74-9(Vol.1), pp 129-145) PARTICLE DETECTORS. Charpak, G. (CERN, Geneva). 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

After a short introduction of the historical development in detecting elementary particles, present detectors are reviewed. They include: scintillation counters, different types of Cherenkov counters (threshold, differential, and total absorption counters), spark chambers, streamer chambers, proportional chambers, and drift chambers. Applications of multiwire chambers in different fields, notably in crystallography and biology, are briefly indicated. (auth)

3540 (CERN-74-9(Vol.1), pp 146-154) HANDLING OF DATA FROM EXPERIMENTS. Davies, H. E. (CERN, Geneva). 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

The use of small computers in on-line experiments in high-energy physics is briefly indicated. The requirement for an above-average performance (data-handling rates up to 1.5 Mbit/sec) is described, emphasizing the problem of data acquisition; data rates and buffering, data storage, and the importance of flexibility are dealt with. The discussion of hardware solutions to the special problems posed by on-line experiments includes the use of CAMAC interfaces, systems of linked computers, and the use of special processors which perform the first steps of data analysis very rapidly. A section on the software solution to data acquisition problems treats the requirements for flexibility and ease of use, giving as an example a comparison of a manufacturer-supplied Editor and CERN's ORION Editor, and concludes with an outline of the need for direct access to more powerful computers, giving as an illustration the FOCUS and Omega/SFM networks. (auth)

3541 (LA-UR-74-633) DELAY LINE READOUT OF ANODE PLANES IN PROPORTIONAL CHAMBERS. Lee, D. M.; Sobottka, S. E.; Thiessen, H. A. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 15p. (CONF-740463-3; ORO-4043-22). Dep. NTIS $4.00.

From meeting of the American Physical Society; Washington, District of Columbia, USA (22 Apr 1974).

Simple delay lines have been developed for reading out active anode wire locations in multiwire proportional chambers. Anode wire positions are read out using commercial fast logic and time digitization apparatus with no special electronics required. (auth)

3542 (LBL-3013) APPLICATION OF THE CLASSICAL THEORY OF ELECTRONS IN GASES TO MULTIWIRE PROPORTIONAL AND DRIFT CHAMBERS. Palladino, V.; Sadoulet, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1974. Contract W-7405-eng-48. 79p. Dep. NTIS $5.45.

The classical theory of electrons in gases is reviewed and some of its results which may be useful in the design of multiwire proportional and drift chambers are discussed. Methods by which low diffusion and constant drift velocity may be obtained in certain gas mixtures are considered, and the multiplication process is examined. (auth)

3543 (LYCEN-7416) CONTRIBUTION TO THE REALIZATION OF A RECOIL SPECTROMETER WITH LARGE APERTURE, TO STUDY COHERENT REACTIONS AT HIGH ENERGIES. Martin, J. P. (Lambda Corp., Arlington, Va. (USA)). 1974. 75p. (In French). Dep. NTIS (US Sales Only) $6.75.

Thesis.

In the first part is presented the missing mass method by detection of the recoil nucleus, and the different fields of physics it allows the study, of particularly coherent processes in nuclear and Coulomb fields, of light nuclei. In a second part, preliminary results concerning a p-^{4}He scattering experiment at 24 GeV/c, presently performed at the CERN Proton Synchrotron are presented. A recoil method based on semiconductor detectors permitted to obtain the elastic scattering cross section and the inelastic cross-section in the 1 to 1.9 GeV range of missing masses. The last section deals with the realization of a recoil spectrometer, i.e., it has a large aperture and is made with sets of semiconductor detectors and multi-wire proportional chambers (MWPC); and the working gas is the target gas itself. The operation of MWPC with the mixture He-Isobutane (10%) at low pressure, and the topological separation of particles with Z-1 and Z-2 by means of a MWPC and a semiconductor detector telescope are studied. Performance of the spectrometer which will allow experiments of coherent scattering with high energy secondary beams of π, K, p or anti p is discussed. (FR)

3544 DEVELOPMENT AND TEST OF A LIQUID-ARGON SHOWER DETECTOR. Knies, G.; Neuffer, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Instrum. Methods; 120: No. 1, 1-7(15 Aug 1974).

A liquid-argon shower detector, consisting of 30 sequential ionization chambers with interleaved converters has been designed. A simple scheme has been introduced to keep capacities low. The test of this detector in a 1.3 GeV/c π^- beam was satisfactory. (auth)

3545 THE DEVELOPMENT OF A NEW DRIFT CHAMBER WITH A NEW GAS MIXTURE. Atac, M.; Taylor, W. E. (National Accelerator Lab., Batavia, Ill. (USA)). Nucl. Instrum. Methods; 120: No. 1, 147-151(15 Aug 1974).

A drift chamber of 1 cm spacing incorporating parallel foils which act as field-shaping electrodes was successfully operated producing a linear space-to-drift time ratio that will enable the determination of positions of charged particle tracks directly from timing spectra. The results indicate that spatial resolutions of 100 to 150 μm can be obtained from a single chamber filled with an argon-methane-acetylene gas mixture at atmospheric pressure. A simplified construction which eliminates field-shaping wires, and uniform equi-potential lines in the chamber which results in uniform electron drift velocities, are the main advantages of this new design. (auth)

3546 DELAY-LINE READOUT OF ANODE PLANES IN PROPORTIONAL CHAMBERS. Lee, D. M.; Sobottka, S. E.; Thiessen, H. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 120: No. 1, 153-156(15 Aug 1974).

Simple delay lines have been developed for reading out active anode wire locations in multiwire proportional chambers. Anode wire positions are read out using commercial fast logic and time digitization apparatus with no special electronics required. (auth)

3547 A LIQUID-ARGON IONIZATION CALORIMETER FOR DETECTION OF ELECTROMAGNETIC AND HADRONIC SHOWERS. Engler, J.; Hofmann, W.; Keim, H. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Experimentelle Kernphysik); Friend, B.; Schmidt-Parzefall, W.; Wegener, D.; Winter, K. (European Organization for Nuclear Research, Geneva (Switzerland)); Nickson, R.; Tyrrell, M.; Willard, T. (Science Research Council, Chilton (UK). Rutherford Lab.). Nucl. Instrum. Methods; 120: No. 1, 157-162(15 Aug 1974).

The performance of a liquid-argon ionization chamber, consisting of a set of eighty 2 mm thick iron plates, is described. Measurements with muons, and electron and proton showers were performed; from these measurements a ratio of 1.2 for the electron-to-proton response was derived. For hadron showers a flood detection efficiency of nuclear spallation products could be established. (auth)

3548 TRACK PARAMETRIZATION IN THE CERN SPLIT-FIELD MAGNET. Aubert, J. J.; Broll, C. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). Nucl. Instrum. Methods; 120: No. 1, 137-141(15 Aug 1974).

Since tracking charged particles through an inhomogeneous field consumes much computer time, an attempt was made to replace it by another method for the CERN-Hamburg-Orsay-Vienna experiment performed in the Split-Field Magnet of the CERN Intersecting Storage Rings. This method has been shown to be sufficiently accurate and faster than a standard tracking method by one order of magnitude. Its use in the reconstruction program of the experiment brought an over-all gain in speed of three for the analysis of proton-proton elastic scattering events. (auth)

3549 A DIRECTIONAL CHERENKOV COUNTER FOR GAMMA-RAY ASTRONOMY. Andresen, R. D.; Arens, I.; Taylor, B. G.; Wills, R. D. (European Space Research and Technology Centre, Noordwijk (Netherlands)). Nucl. Instrum. Methods; 120: No. 1, 85-92(15 Aug 1974).

The mission of the ESRO satellite COS-B requires the detection of relativistic particles incident within a wide field of view and the rejection of particles moving in opposite directions within the same acceptance cone. To meet this requirement a counter has been developed which makes use of the directional emission of Cherenkov light in Plexiglas. Different experimental techniques have been used to evaluate the performance of the counter and the results are discussed in terms of the light-collection efficiency. It has been possible to achieve a forward detection efficiency of 90% with a reverse rejection efficiency of 98%. (auth)

3550 CHARACTERISTICS OF MULTIWIRE PROPORTIONAL COUNTERS WITH DELAY-LINE READOUT FOR MINIMUM-IONIZING PARTICLES. Stetz, A. W.; Perez-Mendez, V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Geaga, J.; Spinka, H. (California Univ., Los Angeles (USA)). Nucl. Instrum. Methods; 120: No. 1, 17-22(15 Aug 1974).

The effect of gas mixture and chamber thickness on the gain and pulse shape of a multiwire proportional counter with delay-line readout have been investigated. The primary concern was with optimizing the position accuracy for high-energy particle physics applications. The best results, both from the point of view of chamber gain and the risetime and uniformity of the delay-line pulses were obtained with a 4 mm gap chamber run on a mixture of 30.2% carbon dioxide, 69.2% argon and 0.6% freon. When using gas mixtures with no electronegative components, it was necessary to bias the outer grids negative with respect to ground to prevent electrons in the drift regions from migrating into the multiplication region and spoiling the delay-line pulse shape. (auth)

3551 IONIZATION MEASUREMENT WITH PEPR I. MacNaughton, J. (Katholieke Universiteit Nijmegen (Netherlands). Fysisch Lab.). Nucl. Instrum. Methods; 120: No. 1, 47-54 (15 Aug 1974).

Results of ionization measurements from PEPR 1 at Nijmegen are discussed. The algorithm for threshold setting for ionization measurement developed by the Oxford group has been incorporated into the system. A sample of about 4000 tracks from four constraint events has been used to calibrate the ionization measurements. Below 0.8 GeV/c 72% of all π and K tracks are identified with $\frac{1}{2}$% error rate. Below 1.5 GeV/c 81% of all π and p tracks are identified with 2% error rate. (auth)

3552 THE PERFORMANCE OF CHARGED-PARTICLE TELESCOPES UNDER ISOTROPIC IRRADIATION. Kolchin, A. A.; Lebedev, V. V.; Skrebtsov, G. P. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). Nucl. Instrum. Methods; 120: No. 1, 55-59(15 Aug 1974).

The following characteristics are considered for a charged-particle telescope under isotropic irradiation: (a) directional response function; (b) geometric factor; (c) response functions for telescope detectors; (d) distribution of particles entering the telescope in path length and energy loss in the transmission detector; and (e) distribution of particles entering the telescope in the projection of their range onto the symmetry axis of the instrument. The relation between these characteristics and the ways of their derivation are shown. (auth)

3553 CHERENKOV LIGHT DETECTION FROM A LIQUID HYDROGEN COUNTER. Spillantini, P. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Nucl. Instrum. Methods; 119: No. 3, 583-587 (1 Aug 1974).

The use of liquid hydrogen Cherenkov counters for the π/K separation in the range 0.7 to 1.5 GeV/c is discussed, and an experimental test of Cherenkov light collection at large angle with respect to the axis of the Cherenkov light cone is described. (auth)

3554 STUDY AND REALIZATION OF A DECISION MATRIX USING THE PROPAGATION OF SIGNALS IN DELAY LINES WITH ECL GATES. Chatelus, Y.; Herzog, P.; Schultz, G. (Strasbourg-1 Univ., 67 (France)). Nucl. Instrum. Methods; 119: No. 3, 589-594(1 Aug 1974). (In French).

A decision matrix has been realized to be associated with multiwire proportional chambers. This device will select high-transverse-momentum particles of one special reaction in a high-energy physics experiment. It makes time coincidences between two electrical signals, which propagate in two delay lines made with ECL gates. The time difference between the input signals defines the mean selected angle. The width of these signals defines the width of the selected angular region. The decision time is less than 85 ns. (auth)

3555 A METHOD FOR STUDIES OF SMALL-ANGLE HADRON–PROTON ELASTIC SCATTERING IN THE COULOMB INTERFERENCE REGION. Vorobyov, A. A.; Korolev, G. A.; Schegelsky, V. A.; Solyakin, G. Ye.; Sokolov, G. L.; Zalite, Yu. K. (AN SSSR, Leningrad. Inst. Yadernoj Fiziki). Nucl. Instrum. Methods; 119: No. 3, 509-519(1 Aug 1974).

A hydrogen-filled ionization chamber used as a target and as a detector of the recoil protons was proposed to be applied for studies of small-angle hadron-proton elastic scattering. The analysis of signals from the chamber electrodes and delay times of the signals made it possible to determine the energy and the emission angle of the recoils, as well as to separate the target volume inside the volume of the chamber. The protons were detected in the energy range 1.0 to 4.0 MeV, with the energy resolution fwhm = 40 keV. The method can be used in a wide range of incident particle momenta at beam intensities of 10^4 to 10^5 particles/s. (auth)

3556 HIGH-RESOLUTION READOUT OF MULTIWIRE PROPORTIONAL COUNTERS USING THE CATHODE-COUPLED DELAY-LINE TECHNIQUE. Lacy, J. L. (National Aeronautics and Space Administration, Houston, Tex. (USA). Manned Spacecraft Center); Lindsey, R. S. (Lockheed Electronics Co., Inc., Houston, Tex. (USA). Houston Aerospace Systems Div.). Nucl. Instrum. Methods; 119: No. 3, 483-498(1 Aug 1974).

Results of work on the cathode-coupled delay-line readout technique are presented. The basic avalanche production mechanisms for magic gas and standard proportional gas are contrasted and their considerable impact on delay-line readout systems is discussed. Results of careful resolution testing of two externally coupled delay-line systems possessing vastly different propagation delays are presented. Results are presented for both magic gas and a standard proportional gas mixture. Magic gas is shown to have considerable advantages both from the point of view of optimizing resolution performance and minimizing the required delay-line propagation delay. For magic gas a minimum ionizing spatial resolution of 100 μm at normal incidence with slow degradation with inclination was measured for a delay-line propagation delay of 11 ns/cm. Much shorter delays are shown to be theoretically possible without loss of resolution. (auth)

3557 THE IDENTIFICATION OF SECONDARY PARTICLES BY IONISATION SAMPLING (ISIS). Allison, W. W. M.; Brooks, C. B.; Bunch, J. N.; Cobb, J. H.; Lloyd, J. L.; Pleming, R. W. (Oxford Univ. (UK). Nuclear Physics Lab.). Nucl. Instrum. Methods; 119: No. 3, 499-507(1 Aug 1974).

A large volume multiwire proportional chamber employing drift paths of up to 2 m in an unconventional geometry is described. This device will distinguish between kaons, pions and protons for all secondaries from 5 GeV/c to over 100 GeV/c and obtain over 300 transverse position measurements on each track to an accuracy of approximately 2 mm. Results from experiments on a prototype in a test beam are given and a possible design for use with a rapid cycling bubble chamber at the CERN-SPS or NAL accelerators is discussed. (auth)

3558 ELECTRONIC INSULATOR AND FEEDTHROUGH FOR USE AT CRYOGENIC TEMPERATURES. Bamberger, J. A. (Brookhaven National Lab., Upton, NY). Cryogenics; 14: No. 10, 575-576(Oct 1974).

An electrical insulator is described which has been designed for use with the superconducting magnet for the Brookhaven 7 ft bubble chamber. An insulator was required which was leak tight to better than 5×10^{-10} std cm^3 s^{-1} leak rate at liquid helium temperature at a pressure of 15 atm, would remain tight during and after repeated cycling from room temperature to liquid helium temperature, would isolate the incoming and outgoing leads from each other and have high dielectric strength, and would have good mechanical strength. Insulators of the described design have been tested and showed trouble free performance during repeated runs of the superconducting magnet including many temperature cycles, and have operated with the magnet energized to 5000 A, corresponding to a central field of ~30 kG with the bubble chamber dynamically expanded more than 100,000 times. (UK)

3559 ACCURACY OF THE LOCALIZATION OF THE TRAJECTORIES IN A HELIUM STREAMER CHAMBER. Krylov, S. A. (Inst. of Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 350-351(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 49-51(1974).

The accuracy with which trajectories are localized in a streamer chamber filled with pure He under a pressure of 1 atm was measured. For magnetic fields H = 2.6 to 8.5 kG the mean-square scatter of the streamers was $\sigma \simeq (0.29 \pm 0.02)$ mm. (auth)

3560 MAGNETOSTRICTIVE WIRE SPARK CHAMBER IN A MAGNETIC SPECTROMETER. Tenishev, A. E.; Skusinets, V. N.; Zybalov, A. A.; Derebchinskii, A. I.; Konovalov, O. G.; Tonapetyan, S. G. (Physical-Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 352-354(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 51-53(1974).

In order to record the spectra of charged particles a multichannel system was employed which used a wire spark chamber with magnetostrictive takeoff of information. The resolving power of the system is ±1 mm. The spectra of the elastic scattering of electrons having an energy of 650 MeV by H, CH_2, and other substances were measured. (auth)

3561 SYSTEM FOR CONTROLLING A MEASUREMENT SCANNING DEVICE. Vyskub, V. G.; Mamaev, V. L.; Mikheev, V. P.; Rozov, B. S.; Shchurenkov, A. A. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 376-378(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 70-73(1974).

A digital-analog system for the stabilization and control of a laser-mirror scanator with a dynamic range $\sim 10^5$ for handling photographs from track detectors is considered. A mathematical model of the sweep device is presented, and experimental results are given. The system that has been developed may be used to control other devices with precise mechanical displacement. (auth)

3562 AUTOMATED SYSTEM FOR MONITORING THE WORKING ORDER OF A HODOSCOPIC INSTALLATION. Vishnevskii, N. V.; Derevshchikov, A. A.; Matulenko, Yu. A.; Nurushev, S. B.; Smirnov, E. V.; Solov'yanov, V. L.; Uglekov, V. Ya. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 382-385(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 76-78(1974).

Monitoring equipment developed in the Institute of High-Energy Physics for the debugging and periodic checking of the main sections of the hodoscopic system before the beginning of an experiment and likewise during it is described. The principal characteristics of the monitoring equipment are presented, and the possibilities of its further expansion are considered. (auth)

3563 FAST CHARGE-DIGITAL CONVERTER. Basiladze, S. G.; Man'yakov, P. K. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 390-393(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 82-85(1974).

A fast analog-digital converter is described which is designed to measure the "area" of pulses in the nanosecond range. The sensitivity of the converter is 600 pC over the entire scale; the number of channels is 256. The maximum conversion time is 4 μsec. The implementation is in the CAMAC standard. (auth)

Radiometric Instruments

Refer also to abstract 3278.

3564 (EURISOTOP-91) COMPUTERIZED CONTROL OF BLAST FURNACE COKE-WEIGHING OPERATIONS USING NEUTRON MOISTURE GAUGES. Cameron, J. F. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). Sep 1974. 27p. Dep. NTIS (US Sales Only) $4.50.

In the production of iron in a blast furnace one of the most important variables to measure is the moisture content of the coke used. This enables the ratio of carbon to iron ore to be maintained at the correct value. Neutron moisture gages provide a unique method of making this measurement, and these gages in combination with a digital data processor enable the complicated coke charging procedure to be controlled precisely and consistently. The system also relieves the operator of much of the tedious routine and provides processed data which helps the operator achieve his targets and plant management to optimize output and operating procedure. The computerized neutron moisture measurement and control system and its technical and economic advantages are described. (auth)

3565 (PB-233484) RAPID PARTICLE SIZE ANALYSIS BY HYDROSIZING AND NUCLEAR SENSING. Report of Investigations. Daellenbach, C. B.; Mahan, W. M.; Armstrong, F. E. (Bureau of Mines, Washington, D. C. (USA)). May 1974. 21p. (BM-RI-7879). NTIS $3.00.

A particle size analyzer for iron ore was developed for rapid size distribution determination. The system sizes particles in a series of hydrocyclone elutriation steps and senses the weight in each of the series by nuclear attenuation techniques. Americium-241 was used as the source. The system was found to predict weight percentage for individual size fractions with an accuracy of plus or minus 0.85 percent or better at the 95% confidence level. (GRA)

3566 USE OF ISOTOPE TECHNIQUES IN THE TEXTILE INDUSTRY. Markiewicz, W. (Textile Research Inst., Lodz, Poland). Przegl. Wlok.; 27: 299-305(1973). (In Polish).

General principles of the use of isotope systems are discussed with chances of their application in the textile industry. Detailed characteristics of isotope meters used in textile production are given. (auth)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstract 3803.

3567 (AD-781306) RADIATION SUSCEPTIBILITY OF HIGH POWER (>200 MW) SPONTANEOUS INFRARED EMITTERS. Polimadei, R. A.; Share, S.; Epstein, A. S.; Gowins, G. E. (Harry Diamond Labs., Washington, D. C. (USA)). Feb 1974. 22p. (HDL-TR-1650). NTIS $4.25.

The effects of neutron and gamma irradiation on high-power (>200 MW) GaAs dome infrared emitters are reported. The threshold radiation levels for degradation of radiated power output, power efficiency, and external quantum efficiency are observed for neutron fluences of 1×10^{12} n/cm^2 (E > 10 keV) and for total gamma doses of 1 million rads (Si). These parameters decrease by three orders of magnitude at 2.2×10^{14} n/cm^2 for the neutron-irradiated device, and at 10^8 rads (Si) for the gamma-irradiated device. The reduction in power efficiency and external quantum efficiency with irradiation can be explained by the reduction in total minority carrier lifetime. The effect of radiation on the dome is negligible. The results of intensity-voltage and current-voltage measurements confirm that, even under the effects of nuclear irradiation, light is emitted in the diffusion region of the junction and that the charge flow is a diffusion process. (auth)

3568 (AD-781331) LOW TEMPERATURE IRRADIATION EFFECTS IN SiO_2 INSULATED MIS DEVICES. Harari, E.; Wang, S.; Royce, B. S. H. (Princeton Univ., N. J. (USA)). 15 May 1974. Contract N00014-67-Z-0151-0034. 29p. (PSSL-150574). NTIS $3.25.

The storage of positive charges in the SiO_2 insulator of MIS devices was studied at both 300 and 80°K. It was found that the additional charge stored in the oxide as a result of low temperature x-irradiation behaves quite differently from that induced by room temperature irradiation. This additional charge may be removed from the oxide by photodepopulation techniques, by field emission and by thermal annealing. The charge associated with traps stable at room temperature is shown to be insensitive to these treatments under the same experimental conditions. The experimental data indicate that the observed behavior is not due to positive ion transport within the oxide and strongly indicate that hole transport is occurring. Models for the trapping sites and the role of surface states are discussed. (auth)

3569 ANOMALOUS SECOND BREAKDOWN FAILURE LEVELS IN GERMANIUM GOLD-BONDED DIODES. Cohn, N. S.; Petree, M. C. (Naval Ordnance Lab., Silver Spring, MD). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 4, 20-22(Aug 1974).

Pulse injection tests on germanium gold-bonded diodes showed that failure due to second breakdown may occur at lower power levels in the forward direction than in the reverse direction. The result is shown to be due to the hemispherical geometry of the junction and the associated spatial variation of the conductivity modulation. Variation between devices of different manufacturers is noted. (auth)

3570 ELECTRON BEAM IRRADIATION EFFECTS IN THICK-OXIDE MOS CAPACITORS. Thomas, A. G. (Western Electric Co., Inc., Kansas City, KS); Butler, S. R.; Goldstein, J. I.; Parry, P. D. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 4, 14-19(Aug 1974).

MOS capacitors were fabricated on n-type ⟨111⟩ silicon wafers with aluminum contacts. The oxide thickness ranged from 1000Å to 12,000Å. These capacitors were irradiated with an electron beam at doses of 10^{11} to 10^{17} electrons/cm^2 and energies of 5 kV and 15 kV. C−V measurements were made to characterize the effects of irradiation. In the thin oxide samples and in the thick oxide samples at 15 kV, the C−V curves revealed a positive fixed charge accumulation in the oxide at dose levels above 10^{13} electrons/cm^2. In the thicker oxide samples at 5 kV there was evidence of negative charge trapping at the lower dose levels changing to positive at the highest dose. In all cases, there was a reversal in the sense of the hysteresis effects in the C−V curves above 10^{15} electrons/cm^2, implying slow surface states which could follow the dc bias voltage but not the ac test signal. There was also a marked increase in the magnitude of the turn-on voltage for strong inversion implying an increase in fast surface states or lateral ionic charge nonuniformities. (auth)

Miscellaneous Instruments

Refer also to abstracts 2793, 2797, 3283, 3838, and 5220.

3571 (BNL-18360) FUNCTIONAL DISTRIBUTION: AN ARCHITECTURE FOR MULTI-USER COMPUTER NETWORKS IN INSTRUMENTATION. Dimmler, D. G. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1973. 20p. (CONF-731112-35). Dep. NTIS $4.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

A new approach is introduced for the design of Multi-User Real-Time Computer Networks. The approach leads to a system architecture called "Functional Distribution." Definitions of the concept and key issues of a practical implementation are discussed using as an example a Multi-User Experiment Control System. The discussion also includes the architecture of that hardware which has been traditionally referred to as the "interface between an experiment and a computer." (auth)

3572 (CEA-CONF-2637) DISCHARGE CURRENT AND ASSOCIATED IONS IN RADIOFREQUENCY SPARK SOURCE MASS SPECTROMETRY. Berthod, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Section d'Etudes et d'Analyses Physico-Chimiques). 1973. 9p. (CONF-730909-2). Dep. NTIS (US Sales Only) $4.00.

From 6th international mass spectrometry conference; Edinburgh, Scotland, UK(10 Sep 1973).

To characterize the ionization process taking place during the individual discharges of an rf spark source, the first task was the design of a convenient detector. A broad bandpass current transformer which develops a voltage proportional to the current flowing in the secondary spark circuit was used. The exploratory experiments, the modifications of the spark circuit, and the significant improvements observed on the photoplate recorded mass spectra are described. (WHK)

3573 (EPRI-78-20-0) USE OF ADVANCED TECHNOLOGIES FOR LOCATING UNDERGROUND OBSTACLES. Final Report. Gates, D. C.; Armistead, R. A. (Stanford Research Inst., Menlo Park, Calif. (USA)). Jun 1974. Contract 14-01-0001-01570. 166p. Dep. NTIS $7.60.

For Electric Power Research Inst., Palo Alto, CA.

This research was directed toward the selection and development of improved methods for detecting and mapping underground obstacles by the electric utility industry. The initial work was concerned with determining existing methods and instruments that hold promise and establishing detection and mapping criteria to be used in the evaluation of new methods. This information was used in a study of five advanced detection technologies, e.g., acoustics, electromagnetics and radar, infrared, magnetics, and nuclear. Several promising detection methods were selected for limited experimental demonstrations. The results of this study led to the recommendation for the construction of a prototype multisensing advanced obstacle detection system consisting of a pulsed UHF radar complemented by magnetometric and inductive magnetic detection techniques. (auth)

3574 (IPNO-73-03) MAG TAPE SYSTEM (M.T.S.). Willis, A. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). 1973. 20p. (In French). Dep. NTIS (US Sales Only) $4.25.

The Mag Tape System consists of a magnetic tape unit coupled to a computer together with a system of programs for handling this tape. The system considerably increases the adaptability of the equipment with which it operates. Although it was not normally designed to operate in conjunction with the nuclear system, it can be inserted into such a system provided that certain precautions are taken. All the different ways in which the magnetic tape can be incorporated into the nuclear system have not yet been completely exploited. Some programs will require modifications, others rewriting. Only the normal exploitation of the Mag Tape System (program assembly, compilations, etc) is given together with its simple utilization in the nuclear system. (FR)

3575 (LMEC-TDR-74-9) TESTING OF LIQUID SODIUM FILM THICKNESS MEASUREMENT SYSTEM USING VARIABLE RELUCTANCE PROXIMITY TRANSDUCERS. Schiowitz, H. H. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 2 Aug 1974. Contract AT(04-3)-700. 189p. AT.

The results of testing of a proximity transducer measurement system procured to the requirements of RDT C 8-2T from Mechanical Technology Inc. (MTI) are described. The system is designed for measurement of the annular spacing between the journal and bearing in hydrostatic bearings used in large liquid sodium pumps. Testing of the system and components of the system was conducted: first, out-of-sodium to determine system and component operating characteristics; and second, with two test article transducers in a test fixture exposed to a liquid sodium environment for 9968 hr. Results of the testing demonstrated satisfactory performance of the two test articles over the extended test period. The two test articles remained in satisfactory operating condition at the conclusion of testing. (auth)

3576 (Y-1961) DIGITAL MULTIPLE PEAK AND VALLEY DETECTOR SYSTEM. Gray, D. H. (Oak Ridge Y-12 Plant, Tenn. (USA)). 14 Nov 1974. Contract W-7405-eng-26. 19p. Dep. NTIS $4.00.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The purpose of this study was to develop a means for determining the position and amplitude of data peaks and valleys, where a peak is the point of maximum amplitude of a Gaussian curve while a valley is the point of intersection between two overlapping Gaussian curves. This technique can be applied to any pulse counting system in which there is a need to find such maximums and minimums. The system was specifically designed for spectra analysis of the mass spectrometer for an ion microprobe mass analyzer. (WHK)

3577 STANDARD PROCEDURES FOR CALIBRATING MAGNETIC INSTRUMENTS TO MEASURE THE DELTA FERRITE CONTENT OF AUSTENITIC STAINLESS STEEL WELD METAL. AWS A4.2-74. Miami, FL; American Welding Society, Inc. (1974). 22p. (ICONS-01829).

This standard prescribes procedures for the calibration and maintenance of calibration of magnetic instruments for measuring the delta ferrite content of austenitic stainless steel weld metals in terms of their Ferrite Number. (auth)

3578 A FAST 6-BIT ADC. Centro, S. (Padua Univ. (Italy). Istituto di Fisica). Nucl. Instrum. Methods; 119: No. 3, 595-598 (1 Aug 1974).

A fast and economical ADC is described that operates in track and hold modes up to 10 MHz, and requires a limited amount of components. Very fast ADCs with more than 6 bits are commercially available but they are quite expensive; if lower resolution is sufficient economical solutions are not readily available. (auth)

3579 DIDO—A MOST VERSATILE PATTERN-UNIT WITH FAST DISCRIMINATOR INPUTS AND CAMAC-/PERSEUS-OUTPUT FACILITIES. Quehl, H.; Stuckenberg, H. J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)); Brechtel, H. (Hamburg Univ. (F. R. Germany). 2. Inst. fuer Experimentalphysik). Nucl. Instrum. Methods; 120: No. 1, 41-46 (15 Aug 1974).

A pattern-unit with fast discriminator inputs, strobed coincidences with resolving time of 5 ns, buffer register with standard CAMAC read-out or the very fast PERSEUS read-out is described. The circuit is built in a 4-fold CAMAC plug-in unit. (auth)

3580 DIRECT COMPUTATION ON THE KINETIC SPECTROPHOTOMETRY. Hansen, J. W.; Pedersen, P. B. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nucl. Instrum. Methods; 120: No. 1, 131-135(15 Aug 1974).

This report describes an analog computer designed for calculations of transient absorption from photographed recordings of the oscilloscope trace of the transmitted light intensity. The computer calculates the optical density OD, the natural logarithm of OD, and the natural logarithm of the difference between the limiting optical density OD_∞ and the actual optical density, and the reciprocal of the optical density. The calculated values are displayed on a digital voltmeter or recorded on an XY recorder. Accuracy and linearity of the individual computing circuits are discussed and the overall performance of the system is demonstrated. The computer was especially developed for analysing oscilloscope photos from radiation-chemical pulsed radiolysis. (auth)

3581 POSSIBLE SOURCES OF POLARIZED X-RAYS FOR X-RAY FLUORESCENCE SPECTRA WITH REDUCED BACKGROUNDS. Howell, R. H.; Pickles, W. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nucl. Instrum. Methods; 120: No. 1, 187-188(15 Aug 1974).

Polarization of the x-ray excitation flux by Compton scattering in x-ray fluorescence analysis can result in improved signal-to-background characteristics in the fluorescent spectrum. Two alternate methods of polarizing the excitation flux, with characteristics differing from Compton scattering, are suggested. (auth)

3582 PROCESS COMPUTERS FOR THE AUTOMATION FOR THE CERN POWER SUPPLY, GENEVA. Ullrich, H. (European Organization for Nuclear Research, Geneva (Switzerland)); Martin, A. (Siemens A. G., Erlangen (F. R. Germany). Geschaeftsbereich Verkehr, Transport, Forschungsstaetten). Siemens-Z.; 48: No. 3, 152-157(Mar 1974). (In German). 6 figs.; 1 ref.

The paper describes the automation system with process computers, the connection of the power supplies with process element and adapter units, demonstrates the modular program systems, and reports on the operation experience gained so far. (GE)

3583 INTENSITY CALCULATION FOR A NEUTRON INTERFEROMETER. Rauch, H.; Suda, M. (Oesterreichische Hochschule, Vienna). Phys. Status Solidi (a); 25: No. 2, 495-505(16 Oct 1974). (In German).

For a perfect-crystal neutron interferometer, an intensity calculation based on dynamic diffraction theory is reported. The reflection curves and defocussing effects for a Laue-type-interferometer are treated including both wave fields. The intensity values and the wavelength distributions for various positions of the interferometer relative to a premonochromator are given. Any phase shifting material within one coherent beam causes typical intensity oscillations damped by the wavelength distribution and other experimental effects. (auth)

3584 KVADRUPOL'NYE MASS-SPEKTROMETRY. (Quadrupole Mass Spectrometers). Slobodenyuk, G. I. Moscow; Atomizdat (1974). 272p.

The book deals with a description of one of the most useful, fast-acting, dynamic mass spectrometers which find wide use in various fields of science and industry in solving such analytical problems as analyzing the composition of a residual gaseous medium and the molecular flux of a substance in vacuum, gas analysis, studying chemical reaction kinetics, processes of sorbing and desorbing various gases on solid surfaces, analyzing the composition of neutral and ionized components in probing upper layers of the atmosphere, in plasma diagnostics, in medicine, etc. The theory of operating quadrupole mass-spectrometers is considered in detail. The limiting possibilities of the mass-spectrometer are analyzed. An analysis is given of various variants in equipment construction, and concrete examples of native quadrupole mass spectrometers are described. 113 refs. 70 figs. (SJR)

3585 ANALOG COMMUTATOR IN THE CAMAC STANDARD. Aref'ev, V. A.; Basiladze, S. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl Transl.); 17: No. 2, 386-389(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 79-82(1974).

The block of the analog commutator implemented in the CAMAC standard is described. The block ensures operation in two modes: arbitrary turn-on of any channel for stipulation of the binary code of its number on the address buses, and sequential connection of the channels by a pulse from the master generator (the scanning mode). The gating circuit may be realized using a field-effect transistor or a relay. The integral nonlinearity of the circuit based on a field-effect transistor does not exceed 0.05% in the range of input signals from 0 to –6 V. The turn-on time of the channel is 1 μsec. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 2746, 3114, and 4104.

3586 (AED-CONF-73-223-008) HEAVY WATER FROM SYNTHESIS GAS BY ISOTOPIC EXCHANGE ACCORDING TO THE TWO-TEMPERATURE PROCESS. Ilgner, H.; Nitschke, E.; Walter, S. 1973. 1p. (In German). (CONF-730698-5).

From European meeting on chemical engineering and ACHEMA congress; Frankfurt am Main, F. R. Germany (20 Jun 1973).

3587 (CEA-CONF-2644) ENRICHED URANIUM NEEDS AND FRENCH-PLANS FOR A GASEOUS DIFFUSION PLANT. Besse, G.; Coates, J. H. (CEA, 75 - Paris (France)). 1973. 18p. (In French). (CONF-730983-25). Dep. NTIS (US Sales Only) $4.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France (11 Sep 1973).

The forecast of requirements for new separation capacity is established by comparing demand and capacity for enrichment. Having determined at what date available capacity will be saturated (capacity proper + stocks), it is possible to work backwards. The construction time for new plants determines when the decision to build must be taken, and the steps required to implement it. The French Atomic Energy Commissariat, as holder of the technique of gaseous diffusion, has prepared a thorough study of the decision process. The study was based on four main lines of activity, i.e., development of barriers; construction of full scale pilot plants for various stages of different types; the development of detailed industrial specifications for a large-scale plant; and economic feasibility studies, in collaboration with foreign partners. This work was started when the Pierrelatte plant was completed in 1967, and will be terminated by 1974, when a decision is scheduled regarding the construction of a uranium enrichment plant for civil purposes. (FR)

3588 (RT/ING-(74)9) HEAVY WATER PRODUCTION. Industrial Process and Plants (A Bibliography, 2nd Rev. Edition). Lavrencic, D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Feb 1974. 400p. Dep. NTIS (US Sales Only) $23.00.

The bibliography covers the literature published on heavy water production. The material is arranged under the following subject headings: General; Bibliographies; Determination and Analyses of Deuterium and Heavy Water; Heavy Water Production (processes, patents, plants, technical and economical aspects); Heavy Water Reactors; and Conferences on Heavy Water and Heavy Water Reactors. Three summary tables on heavy water production plants and HWRs in the world, and some schemes of the production plants are also included. (auth)

3589 ANALYTICAL ELECTRON MICROSCOPY OF DEPOSITS FROM HEAVY WATER PLANT PROCESS STREAMS. Doern, F. E.; Wikjord, A. G. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). (1974). vp.

From 57th Canadian chemical conference; Regina, Saskatchewan (2 Jun 1974)

Scanning electron microscopy and energy dispersive x-ray spectrometry have been used to characterize sulfide corrosion products and other deposits formed in the Bruce Heavy Water Plant operating on the Girdler-Sulfide H_2S-H_2O exchange process. The scanning electron microscope with its great depth of field capabilities was used to determine morphological differences between the inner surface (bonded to the metal) and the outer surface (exposed to the process stream) of the corrosion scales. An integrated energy dispersive x-ray spectrometer equipped with a Si(Li) semiconductor detection system produced a rapid elemental analysis for all elements with atomic number greater than fluorine. Use of the various instrumental parameters and techniques required for semiquantitative analyses are discussed. (auth)

3590 CHEMICAL ANALYSIS IN SUPPORT OF THE GS PROCESS. Stewart, R. B.; Thorpe, J. W.; Mislan, J. P.; Dean, J. R.; Ashley, R. W.; Thurston, W. M. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). (1974). vp.

From symposium on GS process developments; Kincardine, Ontario (19 Jun 1974).

The chemical analysis support for the Canadian GS process heavy water production plants is reviewed. Particular attention is given to progress towards better methods and capabilities made during the past eighteen months. Topics include feedwater analysis, process gas and liquids, the search for foam-promoting impurities, iron and iron deposition and deuterium measurements. Some objectives for the future are indicated. (auth)

3591 FLOW IN ROTATING CYLINDER OF A GAS CENTRIFUGE. Nakayama, W.; Usui, S. (Hitachi Ltd., Tokyo). J. Nucl. Sci. Technol. (Tokyo); 11: No. 6, 242-262(Jun 1974).

Thermal convection and weak forced flows in a rotating cylinder were studied theoretically to find the mass velocity distributions in a gas centrifuge. Compressibility of the gas is taken into account in the form of a density stratification in the radial direction. First of all, a scaling analysis was made to verify the dominance of Coriolis force in the field of flow. The result of this analysis indicated that the body of the fluid in the centrifuge is composed of inviscid cores separated by a viscous layer concentric to the axis of rotation, and enveloped by other viscous layers lining the side and end faces of the cylinder. The transport of the gas from the feed ports to the discharge ports is made through these viscous layers. The thermal convection has its largest component near the side wall in the form of a recirculating flow, and its pattern is controlled by the temperature distribution of the wall. These theoretical results were verified in part by an experiment devised to permit visual observation of the air flow in a rotating cylinder. (auth)

3592 SEPARATIVE WORK OF SEPARATING UNIT FOR ASYMMETRIC PROCESS. Kokubu, H. (Sumitomo Atomic Energy Industries, Ltd., Osaka). Nippon Genshiryoku Gakkaishi; 16: No. 7, 397-403(Jul 1974). (In Japanese).

The value function for a symmetric process depends only on the concentration, and is independent of the separation factor of the separator. In the case of an asymmetric process, however, the value function depends not only on the concentration but also on the separation factor of the separator. The values of the net separative work provided by cascades (net separative work meaning the total value for the separators in all the stages of the cascade minus the mixing losses in the cascade) even when operated under identical conditions (rate and concentration) of product, feed and waste vary with this value function, which is applied to derive the net separative work of the cascade. In order to eliminate this inconsistency, a normalization factor η is introduced to normalize the net separative work of the cascade. A method is proposed for utilizing this normalization factor to make comparisons of the separative work between separators possessing different separation factors. It is shown that the value of η deviates rapidly from unity with accentuating asymmetry of the separation process. It is concluded that normalization such as proposed above is indispensable for comparing the values of the separative work by separators, possessing a large degree of the separation process asymmetry. (auth)

3593 CONCEPTUAL DESIGN OF URANIUM HEXAFLUORIDE TEST LOOP. Muramatsu, T. (Ebara Manufacturing Co. Ltd., Tokyo). Ehara Jiho; No. 88, 38-42(Jun 1974). (In Japanese).

Raw material for the enrichment of uranium is supplied in the form of UF_6, with isotope separation being made by either the gaseous diffusion process or a centrifuge. The present design is made for disclosing many factors about the diffusion plant operation, in which behaviorally unverified UF_6 is used as material. Accordingly, a loop is planned which is capable of simulating a real diffusion plant with regard to temperature, pressure, and flow rate. This facilitates empirical operation and at the same time, makes an axial compressor test possible. In the conceptual design, the built-in equipment as a loop system is examined and the structure and attached facilities are planned, where the study was made from many angles involving safety, workability and maintainability. (auth)

3594 IDEAL CASCADE FOR ASYMMETRIC PROCESS. Kokubu, H. (Sumitomo Atomic Energy Industries, Ltd., Osaka). Nippon Genshiryoku Gakkaishi; 16: No. 6, 330-341(Jul 1974). (In Japanese).

A method of calculation is proposed for finding the flow rate at each stage in an asymmetric ideal cascade for the case where $\alpha = \beta^{s/t}$, α and β being the head and tail separation factors, respectively, while s and t are integers. Using this method of calculation, the values of the flow rate at each stage in the asymmetric ideal cascade for $\alpha = \beta^5$ and $\alpha = \beta^{1/2}$ are calculated. (auth)

Isotopic Power Sources

Refer also to abstracts 3210, 3211, 3324, and 5257.

3595 (DPST-74-128-8) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Aug 1974. Contract AT(07-2)-1. 23p. Dep. NTIS $4.25.

Parameters used for fabricating two additional batches of shards are listed. One batch (S-8) is the first attempt at SRL to fabricate dense, <500-μm-diameter shards for the milliwatt generator. The other batch (S-9) consists of PPO shards fabricated following LASL guidelines for outgassing, cold pressing, breakup, and presintering. During calcination, oxygen exchange, and outgassing of ^{238}Pu, the time and temperature should be controlled to obtain the highest density in milliwatt fuel and to minimize variations in the fabrication of PPO spheres. Shards for 82% dense PPO spheres can be stored up to 8 months without producing microstructural damage on hot pressing. Two iridium PICS's were successfully welded together in an existing TIG welder. Processes are being developed for decontaminating PPO spheres (PISA's) by electrolytic deplating of iridium and by ultrasonic decontamination. (auth)

3596 (DPST-74-128-9) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Sep 1974. Contract AT(07-2)-1. 25p. Dep. NTIS $4.25.

^{239}PuO$_2$ powder may be a suitable stand-in for ^{238}PuO$_2$ powder in the measurement of specific surface area by the BET method. CeO$_2$ was shown to be a suitable simulant for tests of the production hot press for PuFF at the vendor's shop. These tests are scheduled for October 1974. Sintered shards with the desired characteristics for use in the Milliwatt heat source were made from oxalate-based ^{238}PuO$_2$ feed. These shards were loaded along with yttrium metal into a 3.5 W_{th} Milliwatt design capsule to the required power density of 2.22 W_{th}/cc. (auth)

3597 (MLM-2184) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: JULY–SEPTEMBER 1974. (Mound Lab., Miamisburg, Ohio (USA)). 25 Oct 1974. Contract AT-33-1-GEN-53. 8p. Dep. NTIS $4.00.

During July to October 1974 the Isotopic Fuels Programs concentrated on substoichiometric studies of fuel particles and development of a method for preparing metal carbides. Plutonium-238 dioxide particles were reduced to ^{238}PuO$_{1.88}$ in vacuum at 1900°C. Microscopic examination revealed the characteristic two-phase structure of ^{238}PuO$_{2-x}$ in the reduced particles. Upon oxidation, the two-phase structure was still observable, although thermogravimetric analysis shows that the particles were stoichiometric. Ignition of tricyanomethide salts provides a new method of preparing metal carbides. Unusual carbides, such as $Cr_{0.62}C_{0.35}N_{0.03}$, may be prepared by controlling the temperature of ignition of the tricyanomethide salt. (LCL)

3598 RECENT STATUS OF PRACTICAL APPLICATION OF TRANSURANIC ELEMENTS. Enomoto, S.; Wada, N. (Japan Atomic Energy Research Inst., Tokyo). Genshiryoku Kogyo; 20: No. 4, 15-26(Apr 1974). (In Japanese).

The use of transuranium elements as heat and radiation sources is reviewed. Topics discussed include ^{238}Pu and ^{244}Cm as heat sources for thermoelectric generators; ^{241}Am and ^{252}Cf as neutron sources; and radiometric gages. (TFD)

Radiation Sources

Refer also to abstracts 3581, 3598, and 4050.

3599 INTEGRITY AND TEST SPECIFICATIONS FOR SELECTED BRACHYTHERAPY SOURCES. Regulatory Guide 6.2, Revision 1. Washington, DC; Atomic Energy Commission, Directorate of Regulatory Standards (1974). 2p. (ICONS-01808).

Manufacture of brachytherapy sources containing byproduct material is an activity requiring a license pursuant to section 30.3, "Activities Requiring License," of 10 CFR Part 30, "Rules of General Applicability to Licensing of Byproduct Material." Brachytherapy sources manufactured under such license must meet certain integrity requirements and pass certain tests. Paragraph 32.74(a)(2)(iii) of 10 CFR Part 32, "Specific Licenses to Manufacture, Distribute, or Import Certain Items Containing Byproduct Material," requires that an application for a specific license to manufacture and distribute brachytherapy sources and devices containing byproduct material to persons licensed under Section 35.14, "Special Licenses for Certain Groups of Medical Uses," of 10 CFR Part 35, "Human Uses of Byproduct Material," include a description of procedures for, and the results of, the prototype tests performed to demonstrate that the source or device will maintain its integrity under stresses likely to be encountered in normal use and accidents. Paragraph 32.74(a)(2)(iv) of 10 CFR Part 32 requires that the application also include details of the quality control procedures which assure that production sources and devices meet the standards of the design and prototype tests. This guide describes integrity requirements and test specifications acceptable to the Regulatory staff for selected brachytherapy sources. (auth)

3600 REDUCTION OF THE SCATTERED RADIATION BURDEN IN X-RAY ROOMS. Goettel, K. (Institut fuer Strahlenschutz, Neuherberg, Ger.). pp 283-284 of Umweltschutz bei Nuklearer und Konventioneller Energiegewinnung. Braun, H. (ed.). Stuttgart; Geog Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

The need to reduce the scattered radiation in x-ray rooms is indicated. The materials and material combinations that can be used effectively for such purposes are tabulated. (JSR)

3601 SOLID RADIOACTIVE SOURCES FOR CALIBRATION PURPOSES. Lowenthal, G. C. (Australian Atomic Energy Commission, Research Establishment, Lucas Heights). At. Energy Aust.; 17: No. 3, 2-8(Jul 1974).

Solid radioactive sources with certified disintegration rates were first offered by the AAEC in 1968. General information about these sources is given as well as details concerning ordering procedures, delivery and prices. (AT)

3602 ^{90}Sr–^{90}Y APPLICATOR FOR EXTRACORPOREAL BLOOD IRRADIATION. Holmer, A.; Ericson, M.; Svensson, H.; Westling, P. (Aktiebolaget Atomenergi, Stockholm). Acta Radiol., Ther., Phys., Biol.; 12: No. 2, 107-112(1973).

A simple ^{90}Sr–^{90}Y applicator for the extracorporeal irradiation of the blood is described. The irradiator allows mean absorbed dose rates to a total blood volume of 4 litres of up to 1650 rad/h to be attained. (auth)

3603 TRIPLE BACK-SCATTERING (REFLECTION) OF ELECTRONS IN THE USE OF ^{90}Sr–^{90}Y, ^{144}Ce–^{144}Pr, AND ^{106}Ru–^{106}Rh β-SOURCES. Boyarshinov, L. M. Sov. At. Energy (Engl. Transl.); 35: No. 6, 1123-1124(Dec 1973).

Translated from At. Energ. (USSR); 35: No. 6, 424-425(Dec 1973). This is a summary of paper No. 707/7343 with full copy held at TIC.

The variation in the characteristics of the triple reflection of electrons as a function of the B-source energy was studied. (TFD)

Design and Fabrication

3604 (AD-782009) USAFSAM FACILITY FOR STUDIES UTILIZING LOW-DOSE, LOW-DOSE-RATE IONIZING RADIATION. Interim Report, 1 April 1970–1 January 1974. Siders, J. D.; Krupp, J. H.; Hardy, K. A. (School of Aerospace Medicine, Brooks AFB, Tex. (USA)). Jun 1974. 11p. (SAM-TR-74-16). NTIS $3.00.

A facility was designed and built to provide continuous exposure to low-dose, low-dose-rate ionizing radiation. Four ^{60}Co irradiators were fabricated by Technical Services Division, Oak Ridge Associated Universities (ORAU). A uniform exposure from 500 mrad to 2.5 R/day can be provided to an area of 512 cu ft (8 ft × 8 ft × 8 ft). (auth)

3605 NEW RADIONUCLIDE SOURCE FOR HIGH TEMPERATURE POSITRON ANNIHILATION STUDIES. Bajgar, C.; Dieterly, D. K. (Univ. of Guelph, Ont.). Radiochem. Radioanal. Lett.; 19: No. 3, 201-205(25 Oct 1974).

A source of ^{68}Ge in nickel has been prepared which allows annihilation studies to be conducted at temperatures up to 950°C without significant degradation of the source. The high energy positrons of ^{68}Ge/^{68}Ga are desirable for minimizing undesired surface effects in the materials of interest. Details of the electrolysis of germanium are discussed, along with the annealing techniques required to prepare the source. (auth)

Industrial Uses

Refer also to abstracts 2939 and 3654.

3606 PRIMENENIE RADIOKTIVNYKH INDIKATOROV DLYA ISSLEDOVANIYA METALLURGICHESKIKH PROTSESSOV. (Use of Radioisotopic Tracers for Investigation into Metallurgic Processes). Belyaev, Yu. B. Moscow; Atomizdat (1972). 96p.

The physicochemical bases of radioisotopic tracers are considered. Methods are presented for evaluating the physical and chemical suitability of radioisotopes for studying chemical elements, and methods are given for selecting the necessary amount of indicator for making such studies under industrial conditions. A method is described for determining the homogeneity of the distribution of a radioactive indicator in a medium. Results of studies under actual conditions of blast-furnace, open-hearth, and converter operation are given, and studies of crystallization in steel ingots are discussed. Considerable attention is given to the hydrodynamics of liquid metallurgical systems, which is the basis for study of heat and mass transfer in metallurgical aggregates by radioisotopic methods. The basic directions for organization of work with radioactive indicators under production conditions are considered. (INIS)

3607 APPLICATION OF ELECTRO–OPTICAL IMAGE INTENSIFICATION TO LIQUID DIFFUSION STUDIES. Chiang, S.H.; Hatters, H.D. (University of Pittsburgh, Pittsburgh, Pennsylvania 15261). Rev. Sci. Instrum. 45: No. 11, 1432-1434 (Nov 1974).

This paper describes the development of a radioactive tracer system using an electro–optical image intensifier integrated with a low light level photographic system to permit recording of concentration profiles in liquid systems undergoing diffusion. Diffusivities of liquid components can be rapidly and accurately determined from the resultant concentration position time data. Results for the d–glucose–water system at 25°C are presented. (auth)

3608 HAZARDS FROM STATIC ELIMINATORS USING ^{210}Po IN THE FORM OF MICROSPHERES. Dunster, H. J. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 8, 15-16(Jul 1974).

The findings of a report (Robertson, M. K. and Randle, M. W., Health Phys., 26: 245-250 (1974)), are compared with results from the National Radiological Protection Board, U. K., on the problems of using static eliminators based on ^{210}Po microspheres in industrial conditions. Particular attention is given to the hazard from fragmented microspheres which are inhaled and deposited in the lung. The risk of cancer developing in cells surrounding a fragmented microsphere is discussed briefly in the light of high local dose irradiation of some animals and humans. Recommendations from the report and the National Radiological Protection Board are also compared. (UK)

3609 SEMI-COMMERCIAL IRRADIATION OF ONIONS IN THAILAND. Loaharanu, P. (Office of Atomic Energy for Peace, Bangkok). Food Irradiat. Inform.; No. 3, 10-13(Jun 1974).

It has been demonstrated that irradiation of onions in order to inhibit sprouting is both technically feasible and commercially practical. In a developing country such as Thailand where production of onions is seasonal and large amounts of onions have to be imported each year, gamma irradiation could play an important role in preventing unnecessary losses. In combination with chill storage, irradiated onions could well be stored for 6 months. The process is economically attractive since a high profit could be made during this 6 month period. In Thailand, the future of this unique process appears promising. It is expected that at least twice the quantity of onions will be irradiated during the next season. (auth)

3610 STERILIZATION OF FROZEN OR POWDERED EGGS BY IONIZING RADIATIONS. Moore, J. (Laboratoire Central d'Hygiene Alimentaire, Paris). Food Irradiat. Inform.; No. 3, 14-19(Jun 1974). (In French).

In addition to the chemical, physical or biological, and thermopasteurization methods traditionally used for the preservation of frozen or powdered eggs, ionizing radiations at low doses are being studied for this use. The possibilities of industrial utilization of radiopreservation are briefly indicated. Tests made to prove that irradiated egg products are edible and safe are summarized. An economic comparison is made of radiopreservation and thermopasteurization. The studies still necessary before legal approval can be given to this process are outlined. (JSR)

3611 PROGRESS IN FOOD IRRADIATION: BELGIUM. Lievens, F. (Administration de la Recherche Agronomique, Brussels). Food Irradiat. Inform.; No. 3, 39-44(Jun 1974).

A brief status report on food irradiation in Belgium is presented. Topics discussed include radiation sources and dosimetry; chemical changes in irradiated foods, microbiological effects of radiation; and economic aspects. (TFD)

3612 PROGRESS IN FOOD IRRADIATION: FRANCE. Lamy, R. (CEN de Cadarache, Saint-Paul-les-Durance, France). Food Irradiat. Inform.; No. 3, 45-59(Jun 1974). (In French).

On the basis of a literature review, the present status of food irradiation in France is summarized. The topics discussed are irradiation sources and dosimetry, chemical and microbiological modifications, irradiation techniques, edibility, legislation and control, and economic aspects. A list is given of institutions concerned with radiopreservation of food. (35 references) (JSR)

3613 PROGRESS IN FOOD IRRADIATION: GERMANY. Diehl, J. F. (Institut fuer Strahlentechnologie, Karlsruhe, Ger.). Food Irradiat. Inform.; No. 3, 60-70(Jun 1974).

A brief status report on food irradiation in West Germany is presented. Topics discussed include radiation sources and dosimetry; radiation chemistry; radiation microbiology; radiation treatment of various commodities; wholesomeness; legislation; economics; market trials; and consumer acceptance. (TFD)

3614 RV-1200 RADIATION TECHNOLOGICAL FACILITY FOR VULCANIZING THERMOSTABLE ADHESIVE ELECTRICALLY INSULATING TAPE AND RUBBER-GLASS-FABRIC COMPOSITE. Pekarskii, N. A.; Osipov, V. B.; Poddubnyi, I. Ya.; Lebedeva, G. N.; Mamikonyan, S. V.; Terent'ev, B. M.; Aver'yanov, S. V.; Chistov, E. D.; Gol'din, V. A.; Safin, R. R.; Marfin, G. I. Sov. J. At. Energy (Engl. Transl.); 36: No. 2, 199-203(Feb 1974).

Translated from At. Energ. (USSR); 36: No. 2, 155-159(Feb 1974).

The RV-1200 full-scale radiation-chemical reactor, which has already undergone technological tests, has been put into service in the Soviet Union and has begun producing industrial products. The facility which uses a ^{60}Co source is briefly described. Research carried out to date has shown that radiation-induced vulcanization of rubber mixes with a polyheterosiloxane rubber base produces a highly thermostable electrically insulating adhesive tape and rubber-glass-fabric composite. (TFD)

3615 APPLICATION OF POST-CUTTING CHIP ACTIVATION ANALYSIS TO THE STUDY OF TOOL WEAR. Prasad, K. N.; Jester, W. A.; Remick, F. J. (Pennsylvania State Univ., University Park). Nucl. Technol.; 24: No. 2, 252-259(Nov 1974).

Post-cutting chip activation analysis has been developed for the study of tool wear. In this technique, chips produced during machining are analyzed by neutron activation for a tracer that occurs in the tool. Tungsten was used as a tracer that was inherently present in the tool, and europium was used as a tracer that was added to the tool during its production. It was found that europium fails to effectively meet all the requirements of a tracer in the tool. By using the tungsten in high-speed steel tools and Ti–6 Al–4 V alloy work material, it was shown that (a) a random selection of chips was ineffective in providing useful tool wear information and (b) the traditionally ignored break-in period of tool wear could be used to predict tool life to within the same margin of error as conventional methods, but with potential savings in time and cost. (auth)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 2935, 2967, 2984, 3628, 3644, and 3679.

3616 (CONF-740231-4) DIRECT EVIDENCE THAT PYRIMIDINE DIMERS IN DNA RESULT IN NEOPLASTIC TRANSFORMATION. Hart, R. W.; Setlow, R. B. (Oak Ridge National Lab., Tenn. (USA)). 1974. 14p. Dep. NTIS $4.00.

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

A specific test for the biological role of ultraviolet (uv)-induced pyrimidine dimers in DNA is photoreactivation (PR). Fish contain large amounts of the PR enzyme. Portions of cell suspensions of tissue from various organs of the fish Poecilia formosa were exposed to uv radiation (254 nm), then injected into isogenic recipients. An incident fluence of 20 J/m^2 resulted in 10% of the fish with large granulomas and 100% with thyroid carcinomas. If the irradiated cell suspension was illuminated with PR light before injection, the yields of both types of lesion were reduced ~10-fold. If the PR light was given before the UV exposure, there was no reduction in the numbers of growths. These experiments show that pyrimidine dimers in DNA can lead to neoplastic transformation. (auth)

3617 (CONF-740715-16) DIRECT EVIDENCE THAT DAMAGED DNA RESULTS IN NEOPLASTIC TRANSFORMATION: A FISH STORY. Setlow, R. B.; Hart, R. W. (Oak Ridge National Lab., Tenn. (USA)). 1974. 17p. Dep. NTIS $4.00.

From fifth international radiation research congress meeting; Seattle, Washington, USA (14 Jul 1974).

There is convincing evidence for the hypothesis that DNA damage may result in malignant transformation. A specific test for the biological role of uv-induced pyrimidine dimers in DNA is photoreactivation (PR). If uv-induced tumor production is photoreversible, such a finding would indicate that dimers in DNA lead to neoplastic transformation. Fish were chosen for study because they contain large amounts of the PR enzyme. Portions of cell suspensions of tissue from various organs of fish (Poecilia formosa) were exposed to uv radiation (254 nm) and were injected into isogenic recipients. The percentage of fish with tumors was determined 6 to 9 months later by gross pathology and histological examination. An incident fluence of 20 J/m^2 resulted in 10% of the fish with large granulomas and 100% with thyroid carcinomas. If the irradiated cell suspension was illuminated with PR light before injection, the yields of both types of lesions were reduced ~10-fold. If the PR light was given before the uv exposure, there was no reduction in the number of growths. These preliminary experiments indicate that pyrimidine dimers in DNA can lead to neoplastic transformation. (auth)

3618 PHOTOCHEMICAL INACTIVATION OF TRYPSIN. Kaluskar, A. G.; Grossweiner, L. I. (Illinois Inst. of Tech., Chicago). Photochem. Photobiol.; 20: No. 4, 329-338(Oct 1974).

The quantum yield for inactivation of aqueous trypsin fits the expression $\varphi_i = \Sigma_r f_r \varphi'_r$, where f_r is the fraction of incident light absorbed by residues of type r and the φ'_r are constants. The values $\varphi'_{trp} = 0.012$, $\varphi'_{tyr} = 0.005$ and $\varphi'_{cys} = 0.10$, obtained at pH 3 in the wavelength range 240 to 290 nm, were attributed to independent events by comparing with quantum yields of the initial photochemical products and permanent residue destruction. The proposed inactivating processes were photoionization of one essential tryptophyl residue, photolysis of one essential cystyl residue, and splitting of an essential cystyl residue induced by light absorption in a nearby tyrosyl residue. The initial photochemical process from pH 3 to 7 identified by flash photolysis was the ejection of electrons from approximately two tryptophyl residues, leading to the formation of the disulfide bridge electron adduct and the hydrated electron. It is proposed that one photoionized tryptophyl residue was permanently disrupted and the other was restored through a back reaction that led to a damaged, active enzyme form. An enhanced inactivation quantum yield at flash photolysis light intensities was attributed to a biphotonic process. A model based on one-photon photoionization of tryptophan from a short-lived precursor of the fluorescent state and the biphotonic photoionization of tryptophan via the triplet state is consistent with the experimental results. (auth)

3619 PHOTOCHEMICAL ADDITION OF GLUTATHIONE TO URACIL AND THYMINE. Varghese, A. J. (Ontario Cancer Inst., Toronto). Photochem. Photobiol.; 20: No. 4, 339-343(Oct 1974).

Irradiation ($\lambda > 240$ nm) of thymine in aqueous solution in the presence of glutathione produced primarily 5-S-glutathione-5, 6-dihydropyrimidine and 5-S, S-glutathione-5, 6-dihydropyrimidine. These adducts were obtained in better yields when the irradiations ($\lambda > 280$ nm) were carried out in the presence of triplet-state sensitizers. Reduction of 5-S, S-glutathione-5, 6-dihydropyrimidine with zinc dust in acetic acid yielded the corresponding 5, 6-dihydropyrimidine. When thymine-glutathione adducts were heated in 6N HCl for 2 h, 5-S-cysteine-5, 6-dihydrothymine and 5-S, S-cysteine-5, 6-dihydrothymine were formed. Under these conditions, uracil-glutathione adducts were less stable and were converted to products other than uracil-cysteine adducts. (auth)

3620 EVIDENCE FOR CLUSTERING OF PYRIMIDINE DIMERS ON OPPOSITE STRANDS OF UV-IRRADIATED BACTERIOPHAGE. Minton, K.; Friedberg, E. C. (Stanford Univ., CA). Int. J. Radiat. Biol.; 26: No. 1, 81-85(Jul 1974).

Ultraviolet irradiation of DNA in vivo or in vitro is known to induce dimerization of adjacent pyrimidine residues. When uv-irradiated T4 DNA containing an average of 44 pyrimidine dimers per molecule was incubated with purified T4 uv endonuclease, double-strand breakage of the DNA was clearly demonstrated by sedimentation velocity analysis. The frequency of the enzymatically induced breakage was significantly greater than that predicted by a theoretical analysis of random single-strand nicking. A qualitatively similar result was obtained with uv-irradiated T7 DNA containing an average of 23.4 dimers per molecule. These results showed that the particular form of pyrimidine dimer clustering occurring in both T4 and T7 DNA was the formation of dimers on opposite strands within about 20 nucleotides of each other. This type of clustering is not necessarily related to nucleotide sequence, but may reflect the thermodynamic probability of forming a pyrimidine dimer in DNA very near to an existing one. This observation raised interesting questions concerning the details of the control of DNA repair in vivo, since uncontrolled action of uv-specific endonuclease could result in severing of the phage genome. (UK)

3621 MECHANISM OF RADIATION-CHEMICAL PROCESSES ON RADIATION STERILIZATION OF SOME SEMISYNTHETIC PENICILLINS. Bochkarev, V. V.; Gromov, V. A.; Khrapov, V. V.; Panin, V. I.; Konevskaya, N. D.; Klimova, T. P.; Salikova, G. E.; Molodov, L. A.; Usatyi, A. F. (Inst. of Biophysics, Moscow). Antibiotiki; 18: 394-402(May 1973). (In Russian).

Radiolysis of some semisynthetic penicillins and their fragments was studied with the methods of EPR, IR spectroscopy, and thin-layer chromatography. It was that interruption of the peptide bond and heterocyclic part of the molecule were the primary radiation-chemical processes. Heating of the radiated drugs revealed secondary radical reactions. Comparison of the values of the radiation yields of the radicals in the penicillins and their fragments demonstrated that the aromatic parts of the penicillin molecule had a protective effect. (auth)

3622 PRODUCTION OF DNA STRAND BREAKS BY THE HYDROXYL RADICAL. Achey, P.; Duryea, H. (Univ. of Florida, Gainesville). Int. J. Radiat. Biol.; 25: No. 6, 595-601(Jun 1974).

The circular covalently closed double-stranded replicative intermediate of ϕX174 DNA synthesis (replicative form I, RFI) was irradiated in nitrogen-saturated aqueous solution. Under these conditions OH· and e^-_{aq} were the main primary radicals and the yield of H· was approximately one-fifth of the other two species. The DNA was protected from radioinduced strand breaks by the hydroxyl scavengers, potassium ferrocyanide and potassium iodide. Addition of potassium permanganate, which reacts with the electron and the hydrogen radical, afforded little protection. Potassium nitrate, which is an efficient electron radical scavenger, produced little protection against strand breaks. The hydroxyl radical was apparently the important species of water radiolysis involved in secondary radiation damage to DNA expressed as strand breaks. An important feature of this study was that the analysis for radiation damage was performed without exposure of the DNA to extensive chemical treatment or unknown cellular enzymes. (auth)

3623 LETHALITY AND DNA BREAKAGE FROM ^{32}P AND ^{33}P DECAY IN BACTERIOPHAGE T4. Ley, R. D.; Krisch, R. E. (Argonne National Lab., IL). Int. J. Radiat. Biol.; 25: No. 6, 531-537(Jun 1974).

To examine the importance of nuclear recoil in biological damage from ^{32}P decay, the production of double-strand breaks (DSB) in the DNA of coliphage T4 by ^{32}P and ^{33}P was compared. ^{33}P has the same decay scheme as ^{32}P, but a much lower nuclear recoil energy (1.7 eV versus 20 eV). When labeled phage were stored at −196°C in a glycerol-casamino acid storage medium, the lethal efficiency per decay was 0.058 for ^{32}P and 0.022 for ^{33}P. The efficiency of induction of DSB's determined by neutral sedimentation of extracted DNA, was 0.057 for ^{32}P and only 0.014 for ^{33}P. These results indicated that the great bulk of ^{32}P lethalities in this phage at −196°C were due to DSB's resulting from nuclear recoil. Killing by either isotope was increased when storage was at 4°C; and the presence of 2-aminoethylisothiouronium (AET) gave partial protection against killing at 4°C. However, the induction of DSB's by ^{32}P decay was little affected by these variables or by storage as extracted DNA versus intact phage, all as predicted if DSB's resulted primarily from nuclear recoil. (auth)

3624 EFFECT OF OXYGEN AND NITROAROMATIC CELL RADIOSENSITIZERS ON RADIATION-INDUCED PHOSPHATE RELEASE FROM 3'- AND 5'NUCLEOTIDES: A MODEL FOR NUCLEIC ACIDS. Raleigh, J. A.; Whitehouse, R.; Kremers, W. (Whiteshell Nuclear Research Establishment, Manitoba, Can.). Radiat. Res.; 59: No. 2, 453-465(Aug 1974).

The 3'- and 5'-phosphate bonds in mononucleotides are not equivalent with respect to radiation-induced breakage. In nitrogen-saturated solution, the ratio of 3' to 5' scission is 2-3 to 1 depending on the structure of the nucleotide base involved. In the presence of oxygen this ratio is reduced to 0.4-1.7 to 1 so that the hypoxic 3' selectivity is diminished and, in some cases, reversed by oxygen. These findings may be helpful in understanding a similar 3' selectivity and oxygen effect reported for DNA. At the mononucleotide level, nitroaromatic radiosensitizers (e.g., nitrobenzenes and nitrofurans) resemble oxygen in that the 3' selectivity is systematically reduced with increasing sensitizer electron affinity. This effect of oxygen and the nitroaromatic compounds is largely due to a small, or negative enhancement of phosphate bond breaking in the 3'-isomers of the mononucleotides. The nucleotide radical-sensitizer interaction leading to these results appears to be a balance between radical adduct formation and electron transfer oxidation with the balance being dependent on the structure of both sensitizer and nucleotide. (auth)

3625 EFFECTS OF CUPRIC IONS ON THE RADIOLYTIC INACTIVATION OF LACTATE DEHYDROGENASE. Winstead, J. A.; McNees, D. E. (Air Force School of Aerospace Medicine, Brooks Air Force Base, TX). Radiat. Res.; 59: No. 2, 466-474(Aug 1974).

The effects of cupric ions on the radiolytic inactivation of beef heart lactate dehydrogenase and rabbit muscle enolase were investigated. A significant radiolytic sensitization of lactate dehydrogenase by Cu^{2+} was observed, but no sensitization of enolase occurred. A decrease of sulfhydryl groups resulted when lactate dehydrogenase was irradiated in the presence of Cu^{2+} ions. The Cu^{2+} was a competitive inhibitor, thus indicating binding to the active-site of lactate dehydrogenase. A mechanism involving the binding of Cu^{2+} to the essential sulfhydryl groups of lactate dehydrogenase and an attack by OH radicals is proposed to account for the radiolytic sensitization observed. (auth)

Radiation Effects on Cells

Refer also to abstracts 3640, 3641, and 5036.

3626 (BNL-19274) SELECTIVE IMMUNO-SUPPRESSION BY RADIATION. Chanana, A. D.; Cronkite, E. P.; Joel, D. D. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 54p. Dep. NTIS $5.75.

The lymphocytic family of cells is very sensitive to radiation. The basic reasons for employing radiation as an immunosuppressive agent are to destroy existing lymphocytes as well as to suppress production of new cells and thereby interfere with their role in immunological reactions. In view of the difficulties in the clinical application of lethal and sublethal whole-body irradiation for immunosuppression, investigators have attempted a variety of techniques to radiate selectively immunocompetent lymphocytes. The observation that many lymphocytes recirculate from blood to lymph and back to blood has provided one basic lead in the development of these techniques. This unique physiological phenomenon of lymphocyte recirculation enables one to deplete many of immunocompetent, recirculating lymphocytes by radiation without producing harmful effects to the body at large. Techniques that have been explored for selective immunosuppression by radiation include the following; surface radiation applicators for individual lymphoid organs such as the spleen and the appendix; radiation of individual lymphoid organs such as the thymus and the spleen; radiation of allografts either in the immediate post-transplant period or during the rejection episodes; indwelling intravascular radiation sources; intravascular or intralymphatic injections of radioisotopes; and extracorporeal irradiation of blood, central lymph, and regional efferent lymph. The historical aspects of selective lymphocyte irradiation are reviewed as well as the problems concerned with dosimetry and the radiosensitivity of circulating blood elements other than lymphocytes. (auth)

3627 (CNAEM-R-127) RADIOPROTECTIVE AND METABOLIC EFFECTS OF AET ON RAT EMBRYONIC CELLS IN CULTURE. Senguen, A.; Boeluekbasi, E.; Uecer, E.; Anil, D. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

The experimental results confirm the literary data on the radioprotective activity of AET. This radiation protection was demonstrated in the increase of survival of rat embryonic cells exposed to various doses of ionizing radiation in culture. Concerning the mechanisms of action, it seems important that a correlation exists between the radioprotective and metabolic effects of the compound, the latter manifesting itself in depression of DNA, RNA, and protein syntheses of pretreated cells. It is suggested that slowing of the metabolic activity and mitotic cycle in cells leads to a state of their enhanced radioresistance or repair capability. (auth)

3628 (COO-1704-28) STUDIES ON THE RADIATION AND CHEMICAL-INDUCED MOLECULAR DAMAGES, THEIR REPAIR AND BIOLOGICAL EXPRESSION IN MAMMALIAN CELLS. Terminal Technical Report. Trosko, J. E. (Michigan State Univ., East Lansing (USA)). 1972. Contract AT(11-1)-1704. 36p. Dep. NTIS $5.00.

Progress is reported on the following research projects: ultraviolet, x-ray, and caffeine synergism with mutagenesis in Chinese hamster cells; synergistic effects of ultraviolet and caffeine on the molecular weight of DNA in uv-irradiated Chinese hamster cells; repair of uv-induced pyrimidine dimers in Drosophila melanogaster; kinetics of repair of uv-induced dimers in human cells; excision repair in cattle showing hereditary predisposition to active skin cancer of the eye and eye lids; environmental modification of the repair of damaged DNA in human cells; repair of DNA damage in other animal systems; and acetophenone-induced pyrimidine dimers in human cells. (HLW)

3629 (SGAE-2324) INFLUENCE OF VINBLASTINE ON THE DNA-METABOLISM IN TUMOR CELLS. Cabela, E.; Klein, W. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Biologie). Aug 1974. 13p. (In German). (BL-102/74). Dep. NTIS (US Sales Only) $4.00.

Studies on the influence of Vinblastine on normal and tumor cells show that semiconservative DNA-synthesis correlates with the enzymatic activity of thymidinkinase. DNA repair investigations performed with Yoshida-Ascites cells indicate an inhibition effect on the ligase system after Vinblastine treatment and gamma irradiation. (auth)

3630 EFFECT OF HYPOXIA ON THE GROWTH AND RADIATION RESPONSE OF MAMMALIAN CELLS IN CULTURE. Bedford, J. S.; Mitchell, J. B. (Vanderbilt Univ., Nashville). Brit. J. Radiol.; 47: No. 562, 687-696(Oct 1974).

During prolonged hypoxia, a progressive change occurs in the radiosensitivity of cultured mammalian cells. An attempt was made to determine whether this could be explained on the basis of a progressive change in the life cycle or age distribution of cells during hypoxia. Cell population growth kinetics and the cell life cycle were studied by two conventional methods of analysis. Both indicated an appreciable heterogeneity in the cell populations with regard to the ability of individual cells to negotiate their life cycle during hypoxia. This heterogeneity was confirmed by studying the development of individual microcolonies under hypoxia. From this study, the following conclusions were reached regarding changes that occurred during hypoxia: (1) the growth rate was decreased and the life cycle lengthened; (2) the overall proportion of cells in DNA synthesis decreased with time; (3) on average, a disproportionate lengthening of the G1 phase of the life cycle was implicated; and (4) these changes were accompanied by a decrease in the shoulder and an increase in the D_0 for the cell survival curve following irradiation with ^{60}Co γ rays. Changes in the radiation response for reasons other than changes in the life cycle or age distribution could not be ruled out. (auth)

3631 EFFECTS OF IRRADIATION ON RED CELLS. Goldstein, B. D. (New York Univ., NY); Paniker, N. V.; Hartmann, R. C. Brit. J. Haematol.; 27: No. 3, 533(Jul 1974).

Reference is made to a recent paper by Paniker et al. (Brit. J. Haematol.; 26: 39 (1974)) in which the findings of the present authors (Goldstein and Harber. J. Clin. Investigation; 51: (1972)) demonstrating that the acetylcholinesterase (AChE) activity of human red cells, containing high levels of protoporphyrin, declines when they are irradiated with near ultraviolet light, appear to be contradicted. A reply by Paniker and Hartmann states that their observations do not contradict those of Goldstein and Harper as no irradiation was carried out. The main concern of their study consisted of the effect of lipid peroxidation on red-cell membrane AChE in normal, PNH, and 'pseudo-EPP' red cells and did not concern the effects of irradiation. (UK)

3632 REPAIR OF SUBLETHAL DAMAGE AND OXYGEN ENHANCEMENT RATIO FOR LOW-VOLTAGE ELECTRON BEAM IRRADIATION. Tobleman, W. T.; Cole, A. (Univ. of Texas System Cancer Center, Houston). Radiat. Res.; 60: No. 2, 355-360(Nov 1974).

A simple analytic formula for the central axis percentage depth-dose for high energy electrons in the 5-30 MeV range, penetrating homogeneous, low-Z materials ($Z \leq 20$), is derived. Both the intensity due to the primary beam as well as the additional dose due to the ionization electrons are taken into account. Field size variations were not considered at this stage, therefore, the present form only applies on the central axis. Empirical expressions for the position of the maximum dose and the range are used. The final expression is compared with available experimental results and excellent agreement, generally better than 5%, is found. (auth)

3633 SPECIFICITY OF RADIOPROTECTIVE AND CYTOTOXIC EFFECTS OF CYSTEAMINE IN HeLa S_3 CELLS: GENERATION OF PEROXIDE AS THE MECHANISM OF PARADOXICAL TOXICITY. Takagi, Y.; Shikita, M.; Terasima, T.; Akaboshi, S. (National Inst. of Radiological Sciences, Chiba, Japan). Radiat. Res.; 60: No. 2, 292-301(Nov 1974).

Cysteamine at 0.5 to 5 mM effectively kills HeLa S_3 cells, while it is much less toxic in higher concentration (30 mM). The toxicity develops gradually with time as peroxide generates in the medium. Addition of catalase and peroxidase to the culture inhibits the toxic effect of cysteamine. The results suggest that the paradoxical cell-killing action of cysteamine can be ascribed to the generation of the peroxide by the compound ($2RSH + O_2 = RSSR + H_2O_2$). In higher concentrations, cysteamine protects the cells by decomposing the produced peroxide ($H_2O_2 + 2RSH = RSSR + 2H_2O$). Radioprotective effect of cysteamine is not directly related to the cytotoxic action of the compound. The magnitude of dose reduction factor (Y) is a linear function of logarithms of the concentration (X) of the compound ($Y = 1.4 \log X + 1.2$). It is to be noted that the minimum effective concentration is about 0.7 mM and that the protective power reaches saturation at about 30 mM. Ethanolamine, ethylmercaptan and ethylamine are all entirely ineffective for radioprotection of the cells, although they are significantly effective in protecting enzyme (catalase) from radiation-induced inactivation in dilute solutions. None of these cysteamine analogues interferes with cysteamine in the radioprotective action in the cells. (auth)

3634 INITIAL STUDIES WITH A LINE OF RADIORESISTANT RAT TUMOR CELLS. Nash, J. C.; Dalrymple, G. V.; Moss, A. J. Jr.; Baker, M. L. (Univ. of Arkansas, Little Rock). Radiat. Res.; 60: No. 2, 280-291(Nov 1974).

The results of studies with a line of cultured rat sarcoma cells (RT-2 cells) are reported. Survival curves indicate the cells to be highly radioresistant [$D_0 = 240$ rads (air) and $D_0 = 750$ rads (hypoxic)]. The RT-2 cells, originally derived from a hepatosarcoma, retain their malignant potential while in culture. Generation cycle analysis indicates a cell cycle duration of 21 hr; G_1—10.7 hr, S—8 hr, G_2—1.5 hr; M—0.8 hr. With the exception of its high radioresistance, the RT-2 cell responds to x-radiation in a manner similar to many other cultured mammalian cell lines. (auth)

3635 IN VITRO PREFERENTIAL EFFECT OF IRRADIATION ON CULTURED T LYMPHOID CELL LINE. Han, T.; Pauly, J. L.; Minowada, J. (Roswell Park Memorial Inst., Buffalo). Clin. Exp. Immunol.; 17: No. 3, 455-462(Jul 1974).

A comparative study was made of cytocidal effects of x-irradiation on human cultured T and B lymphoid cells. Cytocidal effects of irradiation are expressed as percentage inhibition or percentage reduction, calculated by comparing the ^3H thymidine incorporations or viable cell counts in irradiated and unirradiated cultures, respectively. A higher percentage inhibition was observed in each and every T-cell culture, irradiated with 100 to 4000 rads at days 1 to 4 of incubation. The most significant difference of percentage inhibition between T and B cells ($P < 0.05$-$P < 0.01$) was observed at each irradiation dose level at day 3. A significant percentage reduction of viable T cells (98 to 100%) was noted at 100 rad dose level, whereas only 0 to 3% of B lymphoid cells were killed by this dose of irradiation at days 2 to 4 of incubation. The data clearly indicate that human cultured T lymphoid cells are extremely radiosensitive and B lymphoid cells, on the other hand, are fairly radioresistant. (auth)

3636 THERMALLY ENHANCED RADIORESPONSE OF CULTURED CHINESE HAMSTER CELLS: DAMAGE AND REPAIR OF SINGLE-STRANDED DNA AND A DNA COMPLEX. Ben-Hur, E.; Elkind, M. M. (Brookhaven National Lab., Upton, NY). Radiat. Res.; 59: No. 2, 484-495(Aug 1974).

Because hyperthermia enhances x-ray cell killing, the effect of incubation at 41 and 42°C on the repair of DNA in x-irradiated Chinese hamster cells was investigated. It was found that: at 42°C, cells can repair x-ray induced single-strand breaks and do so even more rapidly than at 37°C. Following large x-ray doses (10 krad and above), pronounced DNA degradation is observed when cells are incubated for more than 2 hr at 42°C. Following small x-ray doses, doses which are sufficient to affect the integrity of a DNA complex but not sufficient to induce an easily detectable number of single-strand breaks, incubation at 41°C slows the repair of the complex. At 42°C, the repair of the complex is atypical with some concomitant DNA degradation. Relative to thermally enhanced cell killing, it is suggested that inhibition of repair of sublethal damage may be related to the slower and/or atypical repair of the complex. The enhancement of lethal damage expression could reflect enhanced DNA degradation. (auth)

3637 ISOLATION OF CHLAMYDIA TRACHOMATIS BY USE OF 5-IODO-2-DEOXYURIDINE-TREATED CELLS. Wentworth, B. B.; Alexander, E. R. (Univ. of Washington, Seattle). Appl. Microbiol.; 27: No. 5, 912-916(May 1974).

Irradiated McCoy cells have provided a useful technique for the isolation of Chlamydia trachomatis strains, among which are found the etiological agents of trachoma, inclusion conjunctivitis, and lymphogranuloma venereum. Because irradiation is not always readily available, 5-iodo-2-deoxyuridine (IUDR) treatment of cells was investigated as a substitute procedure. IUDR-treated cells were found to be as sensitive to C. trachomatis infection as were irradiated McCoy cells. Stock chlamydial strains gave similar titers of iodine-stained inclusions in either system. When cells treated with IUDR were compared with irradiated cells for the isolation of C. trachomatis from clinical specimens, 5 of 138 specimens yielded isolates in IUDR-treated cells not found in irradiated ones, and one isolate was obtained from irradiated but not from IUDR-treated cells. In those 56 cases where inclusions were seen in both systems, there were significantly more inclusions in IUDR-treated than in irradiated cells. Although this series of cultures is too small to determine whether IUDR-treated cells are superior to irradiated ones for the isolation of C. trachomatis, the data indicate that IUDR treatment is at least equally effective. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 3621, 3657, and 3662.

3638 (COM-74-11259) HOST RANGE STUDY OF BLUE-GREEN ALGAL VIRUSES. Kraus, M. (Delaware Univ., Newark (USA)). Apr 1974. Contract NOAA-2-35223. 33p. (DEL-SG-1-74). NTIS $3.25.

Information gained on the molecular ecology of a host/virus system covering a rather wide range of blue-green algal viruses and their hosts is summarized. Knowledge gained to date from the host-range data was applied in: interpreting survival curves of blue-green algal viruses as a function of radiation dose; formulating a methodology for the examination of fish kills; characterizing new and old viruses; and establishing a blue-green algal host/virus system as a model of principles and mechanisms in the examination of viruses in polluted or eutrophic water. (GRA)

3639 (COO-3482-22) RADIATION RESPONSE OF BACTERIAL RADIATION REPAIR SYSTEMS. Final Report, January 1, 1970–June 30, 1974. Bruce, A. K. (State Univ. of New York, Albany (USA). Research Foundation). 1974. Contract AT(11-1)-3482. 12p. Dep. NTIS $4.00.

Survival of irradiated cells is dependent on the function of a multiplicity of processes, the failure of any one causing lethality. The ability of radiation repair processes to perform their function in an irradiated cell depends on both the constitutive level of the repair system, and the response of the repair system itself to radiation exposure. Mutant UV17 of the highly radioresistant bacterium Micrococcus radiodurans has been shown to express an inhibition of DNA polymerase-mediated repair. The repair of single strand breaks, removal of pyrimidine dimers, extent of DNA breakdown and survival are all below that of the wild-type. A purified extract from M. radiodurans exhibits a high radioprotective action when tested in Escherichia coli strain B/r but has little action in other strains. Its mechanism of action appears to be associated with some function of the fil locus. Assay of dimer excision in whole cells and in phage-host systems demonstrates that this step of repair is not affected by irradiation at doses where survival is appreciably affected. A series of yeast mutants with respiratory defects show that the constitutive level of respiration is positively correlated with survival following radiation exposure. Various E. coli strains demonstrate a similar correlation. Respiration gradually falls when bacteria are incubated in growth medium post-irradiation, reaching a minimum (dose-dependent) at 1 to 3 hours which is species-specific. The response is exponential with dose and has two components. This suggests that the energy available to complete repair or other essential processes is a significant contributor to survival. (auth)

3640 OXYGEN DEPLETION IN CELLS IRRADIATED AT ULTRA-HIGH DOSE-RATES AND AT CONVENTIONAL DOSE-RATES. Weiss, H.; Epp, E. R.; Heslin, J. M.; Ling, C. C.; Santomasso, A. (Sloan-Kettering Inst. for Cancer Research, New York). Int. J. Radiat. Biol.; 26: No. 1, 17-29(Jul 1974).

Irradiation at conventional dose rates of an oxygen-equilibrated bacterial cell suspension in a sealed vessel produced breaking survival curves similar to those observed for cells irradiated as a thin layer at ultra-high dose rates. A mathematical model previously derived by this laboratory, which also yielded breaking survival curves, was compared with the surviving fraction measured at both dose rates. This comparison yielded, at the two extremes, determinations of the rate of radiochemical depletion of dissolved oxygen and of the factor K, the oxygen concentration at which the radiosensitivity was halfway between the anoxic and fully oxygenated values. There was a dose-rate dependence in K. For the sealed vessel, determination of the rate of depletion was in essential agreement with that measured directly with an oxygen electrode. The agreement supported the assertion that the breaking behavior was due to oxygen depletion. (auth)

3641 TEST OF THE MIXED-DISULPHIDE HYPOTHESIS OF CYSTEAMINE RADIOPROTECTION. Power, J. A.; Goldstein, L. S.; Harris, J. W. (Univ. of California, San Francisco). Int. J. Radiat. Biol.; 26: No. 1, 91-96(Jul 1974).

Diazenedicarboxylic acid bis (N, N'-dimethylamide) or diamide reacts with and apparently oxidizes free cysteamine. Since protein-bound cysteamine molecules do not display a reactive sulphydryl and were shown not to react with diamide, this reagent was used to test the relative radioprotective efficacies of free and bound cysteamine in intact cells of Escherichia coli B/r, and V79 Chinese hamster cells. The results strongly indicated that the mixed disulphide formed between cysteamine and cellular proteins did not account for the radioprotective action of this amino-thiol, although possible alternative explanations of the observations are also discussed. Oxidation of free cysteamine eliminated radioprotection of E. coli and V79 cells. This result is consistent with the conclusion that amino-thiols protect by mechanisms other than mixed-disulphide formation; the evidence supports the possibility of a hydrogen-donation mechanism. (UK)

3642 EXRB: A MALB-LINKED GENE IN ESCHERICHIA COLI B INVOLVED IN SENSITIVITY TO RADIATION AND FILAMENT FORMATION. Greenberg, J.; Berends, L. J.; Donch, J.; Green, M. H. L. (Palo Alto Medical Clinic, CA). Genet. Res.; 23: No. 2, 175-184(Apr 1974).

PAM 26, a radiation-sensitive mutant of Escherichia coli strain B, is described. Its properties are attributable to a mutation in a gene, exrB, which is cotransducible with malB. It differs from uvrA (also malB-linked) derivatives of strain B in being sensitive to 1-methyl-3-nitro-1-nitrosoguanidine and γ radiation, and in being able to reactivate uv-irradiated phage T3. It differs from exrA (also malB-linked) derivatives of strain B in forming filaments during the course of normal growth as well as after irradiation. When exrB was transduced into a K 12 (lon^{+}) strain, filaments did not form spontaneously. Three-point transductions established the order of markers as metA malB exrB. Based on an analysis of the frequency of wild-type recombinants in a reciprocal transduction between exrA and exrB strains, it was inferred that they are not isogenic and that the order of markers is malB exrA exrB. (auth)

3643 ACTIVATION OF LIPOLYTIC ACTIVITY IN STREPTOCOCCUS LACTIS BY ULTRAVIOLET IRRADIATION. Chander, H.; Kuila, R. K.; Ranganathan, B. (National Dairy Research Inst., Karnal, India). Acta Microbiol. Pol., Ser. B; 6: No. 3, 139-140 (1974).

Cell suspensions of a selected weak lipolytic strain of S. lactis were subjected to uv irradiation. The irradiated cells were plated directly on Tributyrin agar medium. Colonies showing bigger zones of lipolysis and original colonies were isolated and inoculated into sterilized skim milk. Lipolytic activity of the parent and mutant strains was determined after 24 and 48 hrs of incubation. The mutants showed, on an average, 66% more lipolytic activity in 24 hrs and 100% in 48 hrs in comparison to the parent, indicating that the irradiated cells are activated. The intracellular enzymes liberated from the mutants produced on an average 100% more lipolytic activity over the parent strain. The data clearly indicate that the lipolytic mutants are capable of producing more amounts of free fatty acids than the parent strain. (ERB)

3644 DETECTION OF URACIL DIMER IN THE RNA OF UV-IRRADIATED TOBACCO MOSAIC VIRUS. Ouchi, S. (Okayama Univ., Japan); Nanba, H.; Shishiyama, J. Okayama Daigaku Nogakubu Gakujutsu Hokoku; No. 42, 21-25(Oct 1973).

It has been well established that the dimerization and hydration of pyrimidine bases in nucleic acids are intimately related to the inactivation of microorganisms. In this article, the substantial evidence for the dimerization of pyrimidine bases in the RNA of uv-irradiated TMV particles is presented. The ordinary strain of TMV was propagated in the leaves of tobacco plants, Nicotiana tabacum. The virus solution was irradiated in a chamber equipped with germicidal lamps, in frozen state. TMV-RNA was isolated from the uv-irradiated virus, and was subjected to alkaline hydrolysis and the hydrolyzate was fractionated by column chromatography. The dimer fraction extracted with 0.1N HCl was dried in vacuo, and the residue was dissolved in distilled water. The solution was irradiated at 2537A, and the optical density recovery was recorded. Each nucleotide was identified by uv absorption spectrum and thin layer chromatography. As a result, it was found that the quantum yield for the dimer formation in RNA in free state was low as compared with RNA in the whole virus, and that coat protein apparently exerted protective function against uv irradiation. But experimental data are not sufficient to draw any conclusion at this stage, and further analysis is necessary for the elucidation of precise mechanism of inactivation and reactivation of virus. (JA)

3645 EFFECT OF INCUBATION TEMPERATURE ON THE GROWTH AND SPORE FORMATION OF PENICILLIUM ITALICUM AND RHIZOPUS NIGRICANS TREATED WITH IONIZING RADIATIONS. Lezhneva, M. L.; Petrash, I. P.; Koval'skaya, L. P. (All-Union Research Inst. of Canning and Vegetable Industry, Moscow). Prikl. Biokhim. Mikrobiol.; 9: No. 5, 664-670(1973). (In Russian).

The influence of the incubation temperature on the growth and spore formation of fungi Penicillium italicum and Rhizopus nigricans treated with gamma-irradiation dosages producing a similar effect on their survival under optimal conditions was studied. The growth rate of the mycelium of the treated fungi at various temperatures depended on their physiological state. An incubation at temperatures below optimal ones inhibited the growth and spore formation of Rh. nigricans but affected insignificantly those of P. italicum. At 30° the growth and spore formation of both fungi were suppressed. These findings show that it is possible to choose such combinations of procedures of irradiation and storage of fresh fruits and vegetables which inhibit efficiently both radioresistant microorganisms and microorganisms that can develop at various temperatures. (auth)

3646 NOODLE (UDON)-MAKING QUALITY OF GAMMA-IRRADIATED WHEATS. Shibata, S.; Imai, T.; Toyoshima, H.; Umeda, K.; Ishima, T. (National Food Research Inst., Tokyo). Nippon Shokuhin Kogyo Gakkaishi; 21: No. 4, 161-167(Apr 1974). (In Japanese).

Noodle (Udon)-making qualities of wheat irradiated with ^{60}Co gamma rays at the dose levels of 20, 50, and 100 krad were investigated with flours made from Japanese Norin-61 and with the one made by mixing American D. H. W., W. W., and Australian W. A. · F. A. Q. in 3:4:4 ratio. Considerable damage of starch granules by irradiation were estimated from lowered viscosity in Amylogram and increased maltose value. This damage of starch resulted in increased material loss in cooking and inferior physical properties of cooked noodle. Increased dose level of irradiation reflected upon inferior score in sensory analysis, particularly with masticatory feeling. Inferior noodle-making quality of irradiated wheat were well correlated to dose level, where imported wheat was more sensitive than domestic wheat in terms of irradiation effects. (auth)

3647 PROTECTIVE EFFECT OF A NUMBER OF CHEMICAL COMPOUNDS DURING THE ULTRAVIOLET IRRADIATION OF BACILLI PHAGES. Polkhovskii, V. A. Dokl. Akad. Nauk Uzb. SSR; No. 4, 56-57(1974). (In Russian).

Phages of aerobic, spore-forming bacteria of the species Bacillus, Bac. cereus 26/3M, Bac. thuringiensis 617, Bac. subtilis 32 and the standard phage of E. coli T2 were subjected to uv irradiation. The degree of phage inactivation was determined from the decrease in colony count on comparison with control samples. The following chemical substances were added to the phage suspension just before the uv irradiation to a final concentration of 0.1%: beta-mercaptopropylamine (MPA), s-beta-aminoethylthiuronium bromide (AET), gallic acid, propyl gallate, methyl gallate, ethyl gallate, and derivatives of hydrogen cyanide (nitriles)-N_1N^1-di(beta-cyanethyl)-glycocol (H-1), hydroside-N-(beta-cyanethyl)-glycocol (H-2), and beta-ethoxyproprionitrile (H-4). Phage survival during uv irradiation in the presence of a number of protective agents increased by a factor of 1.5 to 10. Protective properties were found in AET, MPA, gallic acid and its derivatives and in the H-2 compound. The effectiveness of the compounds varied with respect to various phages. Gallic acid and its derivatives showed protective properties with high effectiveness for almost all phages. AET and MPA were selective in action. (SJR)

3648 RADIATION SENSITIZATION OF MICROCOCCUS RADIODURANS BY POSTIRRADIATION INCUBATION AT NON-PERMISSIVE TEMPERATURE. Cho, H. O.; Kitayama, S.; Matsuyama, A. (Inst. of Physical and Chemical Research, Wako, Japan). Radiat. Res.; 60: No. 2, 333-341(Nov 1974).

The radiosensitizing effect of postirradiation incubation at 42°C, a nonpermissive temperature, was investigated after exposure of Micrococcus radiodurans to sublethal doses of ^{60}Co γ-radiation. The irradiated cells lost their colony-forming ability with this treatment to an extent that depended on the radiation dose and the time and duration of the postirradiation incubation. Sensitivity to the posttreatment at 42°C is of much longer duration than that observed in the case of chloramphenicol. Since the rejoining of DNA strand scissions was not inhibited at this temperature whereas the cell viability was reduced, the restoration of the sedimentation rate of DNA is apparently not a sufficient criterion for the recovery of cells from radiation damage. (auth)

3649 EFFECT OF X RADIATION ON THE DNA-MEMBRANE COMPLEX FROM ESCHERICHIA COLI. Myers, D. K.; Johnson, L. D. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Radiat. Res.; 60: No. 2, 314-320(Nov 1974).

Moderate doses of x-radiation up to 10 krads appeared to have little effect on the DNA-membrane complex isolated from E. coli. Doses of 100 krads produced only a small effect when intact cells were irradiated in nutrient broth, but larger effects were observed when either intact protoplasts or the lysed DNA-membrane complex were exposed to radiation. Under the latter circumstances, much of the DNA and part of the labeled protein were dissociated from the membrane complex, while most of the labeled lipid remained attached to the membrane. (auth)

3650 ACTIVITY OF POLYGALACTURONASE AND PECTINESTERASE OF PENICILLIUM SP 7/4B AFTER ETHYLENIMINE AND UV TREATMENT. Szajer, I. (Maria Curie-Skoldowska Univ., Lublin, Poland). Acta Microbiol. Pol., Ser. B; 6: No. 3, 119-123(1974).

The mutagenic effect of ethylenimine (EI) and EI-UV radiation on a pectolytic active strain of Penicillium sp 7/4B was tested. To obtain an optimal effect in these mutagens on spore surviving, it was necessary to use EI in 1 : 1000 dilution or EI 1 : 2000–1 : 1000 with uv radiation 1992 erg/mm^2. The testing selection of about 3×10^4 cultures obtained, showed an increase in pectolytic activity in four clones after EI treatment (1 : 1000) and in two clones after EI (1 : 1000) and UV treatment. The observed rise in pectolytic activity was connected with the synthesis of PG. Two clones of the four obtained after EI treatment did not synthesize PE under tested culture conditions. (auth)

3651 DIFFERENCES IN THE OXYGEN-ENHANCEMENT RATIO FOR DOUBLE-STRAND BREAKS IN IRRADIATED DNA ACCORDING TO THE METHOD OF ANALYSIS. Horgan, V. W. (Medical Research Council, Harwell, Eng.). Int. J. Radiat. Biol.; 25: No. 6, 619-626(Jun 1974).

Thin films of T7 bacteriophage DNA containing about 30% water were irradiated in air and in nitrogen with ^{60}Co gamma rays. An oxygen effect on double-strand breakage was shown by sucrose density gradient centrifugation but not by boundary sedimentation analysis. (auth)

3652 CHANGE IN DNA LIGASE ACTIVITY IN B. SUBTILIS CELLS IRRADIATED BY γ-RAYS. Gaziev, A. I.; Sergeeva, S. A. (Inst. of Biological Physics, Pushchino-Na-Oke, USSR). Int. J. Radiat. Biol.; 25: No. 6, 589-593(Jun 1974).

DNA ligase of B. subtilis is highly resistant to radiation. When B. subtilis cells were incubated after their γ-irradiation, activation of DNA ligase took place. This activation was caused by de novo enzyme synthesis in irradiated cells. (auth)

3653 INACTIVATION OF DRIED BACTERIA AND BACTERIAL SPORES BY MEANS OF GAMMA IRRADIATION AT HIGH TEMPERATURES. Emborg, C. (Danish Atomic Energy Commission, Roskilde). Appl. Microbiol.; 27: No. 5, 830-833(May 1974).

Dried preparations with Streptococcus faecium, strain A_21, and spores of Bacillus sphaericus, strain C_1A, normally used for control of the microbiological efficiency of radiation sterilization plants and preparations with spores of Bacillus subtilis, normally used for control of sterilization by dry heat, formalin, and ethylene oxide, as well as similar preparations with Micrococcus radiodurans, strain R_1, and spores of Bacillus globigii (B. Subtilis, var. niger) were gamma-irradiated with dose rates from 16 to 70 krad/h at temperatures from 60 to 100°C. At 80°C the radiation response of the spore preparations was the same as at room temperature, whereas the radiation resistance of the preparations with the two vegetative strains was reduced. At 100°C the radiation response of preparations with spores of B. subtilis was unaffected by the high temperature, whereas at 16 and 25 krad/h the radiation resistance of the radiation-resistant sporeformer B. sphaericus, strain C_1A, was reduced to the level of radiation resistance of preparations with spores of B. subtilis. It is concluded that combinations of heat and gamma irradiation at the temperatures and dose rates tested may have very few practical applications in sterilization of medical equipment. (auth)

3654 HYDROGEN SULFIDE PRODUCTION BY PSEUDOMONAS PUTREFACIENS IN SHRIMP EXPERIMENTALLY PACKED IN NITROGEN. Lapin, R. M.; Koburger, J. A. (Univ. of Florida, Gainesville). Appl. Microbiol.; 27: No. 4, 666-670(Apr 1974).

Shrimp refrigerated in a nitrogen atmosphere develop off-odors not typical of normal spoilage. Investigations of this phenomenon showed that hydrogen sulfide developed in the headspace gas, and a large percentage of the microbial population present on the shrimp stored in nitrogen was capable of hydrogen sulfide production, in contrast to the flora on shrimp stored in air. The predominant hydrogen sulfide-producing organism, Pseudomonas putrefaciens, was present in low numbers on fresh shrimp but usually reached high numbers by day 8 of nitrogen storage. Further studies revealed that cysteine and cystine were the probable substrates in shrimp utilized by this organism for hydrogen sulfide production. When shrimp sterilized by irradiation were inoculated with P. putrefaciens and incubated in an atmosphere of nitrogen, hydrogen sulfide and the characteristic off-odors developed. (auth)

3655 ASSESSMENT OF IRRADIATED FOODS FOR TOXICOLOGICAL SAFETY: NEWER METHODS. Chauhan, P. (Bhabha Atomic Research Centre, Bombay). Food Irradiat. Inform.; No. 3, 20-38(Jun 1974).

A discussion is presented of some of the newer methods for evaluating the teratogenicity, mutagenicity, and carcinogenicity of irradiated foods. Problems remain in interpreting the results of teratogenicity and mutagenicity tests and extrapolating these to man. (ERB)

3656 WOOD STERILIZATION BY GAMMA IRRADIATION. Yamamoto, M. (Taisei Construction Co. Ltd., Tokyo); Mizushina, T.; Miyazaki, H.; Tsuda, E.; Mitomi, Y. Taisei Kensetsu Gijutsu Kenkyusho-Ho; No. 6, 15-39(Oct 1973). (In Japanese).

The radiation susceptibility of parasites in wood and the technical possibility of applying radiation to exterminate vermins, in place of conventional methods such as the smoke processing with poisonous gas and immersion in chloric insecticide, were studied. Parasites living in Japan were used as experimental material, since those in imported wood are difficult to obtain and sustain because of the plant disease prevention law and the technical restriction to raising. The lethal dose within 24 hr is 250 to 300 Krad, although the difference of radiation susceptibility is found among the materials according to different time after feathering. The tendency of more susceptibility in case of female than male was found, which will need to be examined in detail. The obstruction of crystallization and sterilization are performed perfectly at every stage by 12 Krad of irradiation. The lethal dose and the dose required for sterilization were also studied regarding parasites in wood. (JA)

Radiation Effects on Plants

Refer also to abstracts 3655 and 3773.

3657 (DEU-73-7) BIOSTACK EXPERIMENT M-221. Apollo 16. Second Quarterly Report. Buecker, H. (comp.). (Frankfurt Univ. (F. R. Germany). Arbeitsgruppe fuer Biophysikalische Weltraumforschung). Dec 1972. vp.

During the second quarter of postflight analysis of the BIOSTACK experiment M-211 flown on board Apollo 16, the spectrum of biological effects observed to be induced by cosmic HZE particles was extended. Some biological processes were shown to be not remarkably or only slightly influenced by a hit of a cosmic heavy ion. These are the germination of hit Arabidopsis thaliana seeds and the growth of hit Vicia faba radiculae. Other biological processes were found to be highly sensitive to a hit of a cosmic heavy ion, such as the emergence of hit Artemia salina eggs, strain Hayward and the hatching from hit Artemia salina eggs. Some other biological processes were observed to be disturbed by a hitting cosmic heavy ion. But these effects are not yet numerous enough to be statistically significant. The processes are the germination of hit Bacillus subtilis spores and the outgrowth of hit Bacillus subtilis spores. Further postflight studies will confirm the observed biological effects due to cosmic HZE particles. Analyses of charge and energy loss of the cosmic HZE particles are in progress. A large number of highly charged ions, as high as iron, have been found. After complete analysis, the widespread spectrum of the data obtained will be used to estimate the radiation hazards to biological matter during space flight in regard to cosmic HZE particles. (auth)

3658 OER FOR LOSS OF REPRODUCTIVE INTEGRITY AFTER ACUTE X-RADIATION OF CELLS OF THE PRIMARY ROOT MERISTEM OF ZEA MAYS. Fenner, D. G.; Shepstone, B. J. (Groote Schuur Hospital, Cape Town). Brit. J. Radiol.; 47: No. 562, 697-706(Oct 1974).

The dose-response curve with respect to reproductive integrity for the meristematic cells of the primary root of Zea mays following acute doses of x rays in air and nitrogen was obtained, using well-known mathematical models derived previously to explain the kinetics in the root tip of the broad bean. It was shown that, within limits, the parameters of the dose-response curve were independent of the particular mathematical models used and of the value of the cell-cycle times of the meristematic cells. The extrapolation number was found to vary between 1.4 and 2.4 for roots irradiated in air, and between 1.5 and 1.9 for roots irradiated in nitrogen. The corresponding values obtained for the 37 per cent dose slope were 410 and 1,050 rads respectively. The OER was also derived and found to be 2.6. The results obtained are considered in the light of the available data on other radiobiological systems. (auth)

3659 PECULIARITIES OF GROWTH OF POLLEN TUBES AND SPERMOGENESIS OF COTTON AS A RESULT OF IRRADIATION OF THE POLLEN. Filatova, R. S. (Inst. of Experimental Plant Biology, Tashkent). Uzb. Biol. Zh.; No. 2, 61-64(1974). (In Russian).

The peculiarities of growth of pollen tubes and spermogenesis in cotton as a result of ^{60}Co gamma irradiation were studied. Doses of 3 and 5 kR slowed the growth of the pollen tubes and caused interruption of mitosis in spermogenesis. The number of anomalies increases with increase in dose. A 5-kR dose depressed the formation of viable sperm. (tr-auth)

3660 STORAGE EFFECT IN SEEDS TREATED BY γ RADIATION AND RADIATION SENSITIVITY IN PLANTS. Gol'dshmid, L. G. pp 77 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. I. Moscow; Atomizdat (1971). (In Russian).

Stimulation of maize by presowing irradiation of seeds was studied. The dose changed, in different years, from 100 to 15,000 R and the dose rate from 10 to 500 R/min. Many tens of thousands of plants were studied, starting with sprouting of seeds and ending with determination and analysis of the harvest. Differentiation of male and female inflorescence in the stimulated plants started earlier, and the duration of the phase of ear and flower formation was longer. Studies are presented whose purpose was to study the EPR signal in seeds of the hybrid maize VIR-42 as a function of radiation dose. The dependence of yield of free radicals on dose was clearly shown in curves, and a stable maximum showed at 500 to 560 R with increase in dose to 4000 R and higher less stable maxima appeared. (INIS)

3661 INFLUENCE OF THE CALCIUM/MAGNESIUM RATIO IN THE NUTRIENT SOLUTION ON THE EFFECT OF GAMMA IRRADIATION OF CABBAGE SEEDS. Shaidorov, Yu. I. Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 6, 28-32(1974). (In Russian).

The influence of the calcium/magnesium ratio in the nutrient solution on the manifestation of radiobiological effect of gamma irradiation was investigated. Cultivation of the plants from irradiated seeds on solutions with a similar concentration and anion composition and with a different calcium/magnesium ratio altered the radiobiological effect. An increased content of calcium decreased the biological effectiveness of radiation, whereas an increased content of magnesium enhanced it. (auth)

3662 SPROUT INHIBITION OF ONIONS BY IONIZING RADIATION. IV. Effect of Post-Harvest Treatment on Extension of Irradiation Time for Storage of Onions. Takano, H. (National Food Research Inst., Tokyo); Umeda, K.; Aoki, S.; Sato, T. Nippon Shokuhin Kogyo Gakkaishi; 21: No. 6, 273-279(Jun 1974). (In Japanese).

The dormancy period of onion, Cult. "Sapporoki" was about one month after harvest. Sensitivity of onion to irradiation gradually decreased after the dormancy period accompanied by growth of inner bud. At this stage, inhibition of sprouting could not be achieved when the same was irradiated after three months of harvest. Complete suppression of sprouting was observed in onions irradiated with 3 to 7 Krad during the dormancy period. Usually, harvested onions are dried for two weeks before irradiation. Inhibition of sprouting and keeping quality were attained with the dose of 3 to 7 Krad when freshly harvested onions were irradiated either before or during the drying treatment for storage. Irradiation period could be extended by low temperature storage of onion after harvest. Growth of inner bud suppressed at 3 to 5°C even after three months of storage and the length of inner bud was similar to that of one month old onion. Thus, sprouting was inhibited by irradiation and apical dominance observed for three months from the harvest date when onions were stored at low temperature. Browning of buds was observed in irradiated onions during storage. This was prevented by low temperature storage and such onions have retained good market quality for one month when transferred from low temperature to ambient temperature. (auth)

3663 VERY SMALL DOSES OF RADIATION DETECTED BY USING SPIDERWORT. Ichikawa, S. (Kyoto Univ.). Kagaku (Tokyo); 44: No. 1, 41-45(Jan 1974). (In Japanese).

The increase of mutation frequencies in stamen hairs of spiderwort induced by small doses of radiation is described. The possibility of using the plant for the biological detection of very small doses of radiation is reviewed. The stamen hairs of spiderwort were used in fundamental studies on the loss of multiplication ability and mutation of the somatic cells, and in studies on the relationship between multiplication ability of the cells and somatic aberrations, and the relationship between polyploidy and radiosensitivities, and in determination of RBE of various radiations. Experiments on the mutation frequencies by low dose irradiation were introduced by Mericle et al., and our experiments were reported. According to these experiments the mutation frequencies increased with increasing x-ray doses. Genetic disturbance was more induced by the exposure during growth of stamens than that by the exposure before the occurrence of stamens. In addition, it was found that the effects of scattering x ray were higher than those of γ rays. Previous reports on the mutation frequencies of pink somatic cells in stamen hairs were collected, and the doubling dose of mutation were obtained. As a result, low value, i.e., about I.R. was obtained. The permissible dose according to the recommendation by ICRP were referred. The safety of permissible dose was questionable from the point of genetics. The experimental results in spiderwort and others were compared, and relative problems to them were stated. Finally, problems relating to the cultivation in the biological apparatus were pointed out. The possibility of this apparatus as a detector for very small doses of radiation were stated. (JA)

3664 DEHYDROGENASES OF ORGANIC ACIDS IN NORMAL AND GAMMA-IRRADIATED COTTON. Arslanova, S. V. (Inst. of Experimental Plant Biology, Tashkent). Uzb. Biol. Zh.; No. 2, 78-79(1974). (In Russian).

Isocitrate dehydrogenase was affected much more by gamma irradiation than was malate dehydrogenase, especially immediately after the irradiation. The activity of succinate dehydrogenase was sharply depressed 24 hr after irradiation but was restored later. (MG)

3665 CORRELATIONS BETWEEN NUCLEAR CHARACTERISTICS, GROWTH INHIBITION, AND SURVIVAL-CURVE PARAMETERS (LD_n), WHOLE PLANT D_o AND D_q FOR WHOLE-PLANT ACUTE GAMMA-IRRADIATION OF HERBACEOUS SPECIES. Sparrow, A. H.; Schwemmer, S. S. (Brookhaven National Lab., Upton, NY). Int. J. Radiat. Biol.; 25: No. 6, 565-581(Jun 1974).

LD_{10}s, LD_{50}s, LD_{90}s, and LD_{100}s determined for seedlings of 32 herbaceous plant species given 16-hour gamma irradiation confirmed the relationship previously found between interphase chromosome volume (ICV) or DNA/chromosome and other end-points (log–log regressions had slopes not significantly different from –1 at the 5% level). Radiosensitivities of additional species can be predicted from known ICVs using these regressions. An inverse relationship between average energy absorbed per chromosome (E/Ch) and survival level was demonstrated for the 32 species; extrapolation indicated an average E/Ch of 3.8 MeV before any appreciable effect on survival would be expected. Average E/Ch at the LD_{50} is 4.9 ± 0.3 MeV. Data showed that the determination of either a survival endpoint or 50% growth inhibition (GR_{50}) permitted other end-points to be predicted. A 1 : 1 relationship between GR_{50} (wet or dryweight) and LD_{10} was shown. Whole-plant D_o and D_q (D_o w.p. and D_q w.p.) values were calculated for 12 species and plotted against nuclear volume (NV), ICV or DNA/

chromosome; the latter two showed higher correlations. The significance of D_q w.p. in relation to E/Ch is discussed. (auth)

3666 HYBRIDIZATION IN MODERN ROSES. III. Selfings in Control and Irradiated Plants. Lata, P. (National Botanic Gardens, Lucknow, India). Curr. Sci. (India); 43: No. 21, 690-692(5 Nov 1974).

Several varieties of roses were treated with 3 to 5 Krad of gamma radiation, and reciprocal pollinations were carried out between control and irradiated plants. Observations were made on fruit set, seed germination, and average number of seeds per fruit. The average number of seeds per fruit and seed germination were significantly lower in selfed plants than in hybrids. The life span of seedlings of selfed seeds was shorter than that of hybrid seedlings. (TSS)

3667 RADIOPROTECTIVE EFFECT OF β-INDOLE ACETIC ACID AND ITS STIMULATING EFFECT ON DNA SYNTHESIS IN CELLS OF THE CREPIS CAPILLARIS L. SEEDS. Araratyan, L. A.; Azatyan, R. A. (Lab. of Induced Plant Mutations, Erevan). Tsitol. Genet.; 8: No. 4, 299-302(1974). (In Russian).

The effect of β-indole acetic acid (IAA) was studied as applied to the Crepis capillaris L. seeds for 4.6 and 8 hrs before x irradiation. IAA stimulated the beginning of DNA synthesis, that is manifested in appearance of 10.5% cells with the chromosome aberrations of chromatid type among the damaged cells. In all the variants with IAA application a considerable radiation protection was observed. (auth)

Radiation Effects on Animals

Man

Refer also to abstracts 3313, 3326, 3332, 3356, 3357, 3373, 3374, 3452, 3602, 3627, 3631, 3633, 3641, 3744, 3745, 3778, 4113, 5064, 5416, 5418, 5422, 5423, 5426, and 5430.

3668 (ANU-P-599) RADIATION AND MAN. Titterton, E. W. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Jul 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

Radiation hazards arising from fallout from nuclear weapons testing are compared with radiation doses from background radiation and medical x-rays. It is argued that the risks from nuclear weapons testing are insignificant when compared with other hazards. (AT)

3669 (NP-20226) HAEMÅTOLOGICAL ANALYSIS OF SUBCLINICAL RADIATION DOSES WITH SPECIAL REGARD TO THE MAXIMUM IN LEUKOCYTE VOLUME. Ammer, W. (Heidelberg Univ. (F.R. Germany). Strahlenklinik). 1973. 100p. (In German). INIS.

17 figs.; 111 refs. With abstract. Available from the library of Heidelberg Univ.

In comparative examinations on a normal collective (group A; n = 103) and a radiation-exposed group of people (group B; n = 26), within the framework of extended radiation haematological investigations, electronic blood countings were carried out with the Coulter counter on the leucocyte concentrate with special regard to the determination of the leucocyte volume maximum. The results were compared with the normal peripheral blood data (leucocyte count and differential blood picture) and besides the casuistic evaluation, a statistical one was made. From the determined values it can be seen that the leucocyte volume maximum of the normal collective clearly differs from that of the persons occupationally exposed to radiation, although the dose to this group B is low on the whole, the difference amounting to 0.9 units of the measuring scale of the equipment used. In group A the representative LVM value of 25.7 threshold units was calculated and in group B an average LVM value of 26.6 threshold units. A connection between the LVM localization and the cell distribution spectrum in the peripheral blood could not be confirmed for group A, in group B there was a clear correlation between LVM and the leukocyte count and between LVM and relative lymphocyte count. The electronic blood analysis with plotting of a leucocyte volume distribution curve represents, on the basis of the investigation results, an extraordinarily sensitive indicator for the evidence of subclinical radiation exposures. This finding is of great significance to the haematological radiation protection and should at least in the field of professionally radiation-exposed groups of people be a reason to reexamine this form of extended blood picture analysis and to possibly make use of it for a standard evaluation. (GE)

3670 (NRPB-R-23) STUDY OF CHROMOSOME ABERRATION YIELD IN HUMAN LYMPHOCYTES AS AN INDICATOR OF RADIATION DOSE. IV. A Review of Cases Investigated, 1973. Purrott, R. J.; Lloyd, D. C.; Prosser, J. S.; Dolphin, G. W.; Eltham, E. J.; Tipper, P. A.; White, C. M.; Cooper, S. J. (National Radiological Protection Board, Harwell (UK)). Apr 1974. 32p. Dep. NTIS (US Sales Only) $4.75.

Results from cytogenetic investigations of 46 cases of suspected over-exposure to radiation are reviewed. Brief accounts are given of the circumstances of the exposures and, where possible, physical estimates of dose are included for comparison. Recent work on the use of lymphocyte replicating ability as a biological dosemeter in radiotherapy patients is reviewed. It is considered that for the possible doses involved in most cases of suspected over-exposure this technique lacks the necessary sensitivity. An experiment was carried out to investigate the effect on aberration yields of inadvertent delays to blood samples posted to the laboratory. It was found that at least 6 days delay can be tolerated without detriment to the eventual dose estimate. (auth)

3671 (NRPB-R-24) RADIATION EXPOSURE OF THE PUBLIC: THE CURRENT LEVELS IN THE UNITED KINGDOM. Webb, G. A. M. (National Radiological Protection Board, Harwell (UK)). May 1974. 24p. Dep. NTIS (US Sales Only) $4.25.

The six main contributors to the exposure of the general public to ionizing radiation are natural background, weapons fallout, the nuclear power industry, medical irradiation, miscellaneous sources, and occupational exposure, considered as a component of the genetically significant dose to the entire population. The current state of knowledge about each contributor is briefly summarized. The methods for interpreting the data to give estimates of public radiation exposure are described and the relative contributions to the genetically significant dose (G.S.D.) to the U.K. population are derived. Natural background contributes 83% of the total G.S.D. In addition to the cosmic radiation, an estimate of the average dose rates over the U.K. on a county basis is used to give the range of variations in natural background. The annual dose rates from fallout have decreased over the last decade but still contribute 2.1% of the G.S.D. Medical irradiation is the second largest contributor and the current estimate is about 13% of the G.S.D. Nuclear power waste discharges only account for 0.01% of the G.S.D. compared with 0.4% from occupational exposure. Miscellaneous sources are generally regarded as relatively unimportant but it is estimated that they contribute 0.3% of the total G.S.D. (auth)

3672 (ORNL-tr-2856) ISOPLETHS OF DOSE OF EXTERNAL γ-RADIATION FOLLOWING HYPOTHETICAL REACTOR HAZARDS WITH EMISSION OF NOBLE GASES. Schultz, H.; Voelz, E. Translated by R. G. Mansfield from Atomkernenergie; 21: No. 2, 145-148(1973). 6p. Dep. NTIS $4.00.

There are credible reactor hazards in which the external β and γ radiation of noble gases (^{133}Xe and ^{85}Kr) of a radioactive cloud is as intense as the inhalation exposure of ^{131}I. Therefore it is necessary to know the maximum dose and the dose under the cloud center line, as well as the area irradiated by the far-reaching γ rays. The last fact is described best of all by isopleths of dose. Some examples of isopleths of the external γ dose are included. (auth)

3673 (PB-233569) POPULATION EXPOSURE TO X RAYS, U. S., 1970. (Bureau of Radiological Health, Rockville, Md. (USA)). Nov 1973. 145p. (DHEW/FDA-73-8047). GPO $2.15.

The information presented in this report was obtained from a household interview survey of a probability sample representative of the civilian, noninstitutional population residing in the United States and a followup to facilities for technical information on x-ray examinations performed. A brief description of the statistical design of the survey, the methods of estimation, and general qualifications of the data are presented in Appendix II. Since estimates shown in this report are based on sample rather than on the entire population, they are subject to sampling error. Therefore, particular attention should be directed toward the section "reliability of estimates" in Appendix II which contains charts indicating the relative sampling errors and instructions for their use. (GRA)

3674 (RD/B/M-3015) CRITERIA FOR LIMITING RADIATION RISKS TO THE PUBLIC. Part I. Current Concepts. Wheatley, B. M. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Apr 1974. 28p. Dep. NTIS (US Sales Only) $4.50.

Current concepts used in establishing radiological protection criteria for setting limits to public radiation exposure are reviewed. The formal basis of the criteria in current use, with extensive reference to the recommendations used to formulate statutory limits, are discussed. Attention is drawn to the limitations of the present concepts for use in estimating risks, and brief comments are made on likely future developments. (auth)

3675 (WASH-1351(Rev.3)) REGISTRY OF INFORMATION ON PERSONNEL OVEREXPOSURES TO IONIZING RADIATION.

Third Report, January 1972—May 1974. (USAEC, Washington, D. C.). 1974. 86p. Dep. NTIS $7.50.

The objective of the Registry is the computerization and maintenance of a current record of personnel overexposures to both AEC and state controlled sources of ionizing radiation. This report contains information such as the occupation, training, work experience, and exposure of the overexposed individual that has been extracted from reports of personnel overexposures to employees of AEC licensees and contractors submitted pursuant to Commission regulations and from one report of overexposure to state controlled sources of ionizing radiation. Data on approximately 80 individuals exposed during 1972 and 1973 are included. (CH)

3676 CLINICAL PICTURE AND TREATMENT OF REMOTE AFTEREFFECTS OF RADIATION AND SURGICAL TRAUMA OF THE LARYNX IN CHILDREN WITH PAPILLOMATOSIS. Yunina, A. I.; Bagoshvili, V. A. (Moscow Scientific-Research Inst.). Vestn. Otorino-Laringol.; 2: 53-58(1974). (In Russian).

There were 12 patients with scar stenosis, atresia, deformities, and defects of the walls of the air-conducting and food-conducting tracts, developing after x-ray therapy and surgical therapy of papillomatosis of the larynx in children. Respiration in these patients was realized through a tracheostome, two patients were fed through a gastrostome. There was noted a marked sclerosis and a loss of plasticity of neck tissues in the area of irradiation, underdevelopment and deformity of laryngeal elements. The first stage of the treatment was restoration of patency of the food-conducting tract, the second—of the respiratory tract. Lacking parts of the larynx and trachea were restored with the aid of Filatov's tube with an implanted auto- or homotransplant into it. Only 5 of 12 patients were cured; in 2 cases food-conducting passages were restored and they could do without a gastrostome. The rest of the patients are at various states of restorative therapy. Our observations indicated x-ray therapy to be harmful in papillomatosis of the larynx during the period of growth and formation of the organism and also pointed to considerable difficulties in elimination of the stricture and restoration of the function of cervical organs in children because of the severity of affection and disturbances of repair processes. (auth)

3677 DISTANCE GAMMA-THERAPY OF CHRONIC LYMPHOLEUKEMIA. Tazhibaeva, S. D.; Polyanskaya, A. M.; Petrenko, L. I.; Markaryan, V. G.; Protasova, T. G.; Ankundinov, V. A.; Fainshtein, F. E. Probl. Gematol. Pereliv. Krovi; 19: 33-38(Mar 1974). (In Russian).

Results of distance gamma-therapy in 45 patients suffering from chronic lympholeukemia were summarized. A conclusion was drawn that the most rational sum total focal doses were 800 to 2000 rad on the spleen, and 1500 to 3000 rad on the lymph nodes. A clinico-hematological improvement with the duration of the period of improvement of from 6 months to 2 years was reached as a result of distance gamma-therapy in 25 patients. (auth)

3678 RADIOBIOLOGICAL CONSIDERATIONS FOR PIONS IN RADIOTHERAPY. Feola, J.; Maruyama, Y. (Univ. of Minnesota, Minneapolis). Oncology; 25: 536-557(1971).

A new radiation beam, the π^- meson beam, is being considered for radiotherapy of human neoplasms. It is clear that this beam has special attributes which make it useful in certain types of neoplasms. However, human experience is heavily based on low LET beams, alterations of dose rate, and treatment planning to confine dose to required therapeutic volumes. The use of this new beam must be considered on existing knowledge regarding the natural history of the neoplasms, and the expected biological properties of the pion beam. It is likely that revision of present fractionation schedules will be required but most likely the pions will be useful to treat the residual tumor core of a tumor reduced in size by prior external beam, low LET therapy. (auth)

3679 COMPARISON OF THE CHROMOSOME DAMAGE AND ITS DOSE RESPONSE AFTER MEDICAL WHOLE-BODY EXPOSURE TO ^{60}Co γ RAYS AND IRRADIATION OF BLOOD IN VITRO. Schmid, E.; Bauchinger, M.; Bunde, E.; Ferbert, H. F.; von Lieven, H. (Univ., Munich). Int. J. Radiat. Biol.; 26: No. 1, 31-37(Jul 1974).

Fifteen patients with advanced cancer were exposed to a medical whole-body ^{60}Co γ-irradiation with doses of 10, 19, and 29 rads before local palliative radiation therapy. Chromosome analyses were carried out in lymphocytes of blood samples obtained before, immediately after, and 24 hours after the exposure of the patients as well as after in vitro irradiation of the patients' blood. A comparison of the frequencies of dicentrics + ring chromosomes revealed no significant differences either between the two sampling times after exposure of the patients, or between either in vivo or in vitro samples. The dose-response relations were linear. Due to the low aberration yields occurring in low dose-ranges, the applicability of chromosome damage to a biological dosimetry is a statistical problem. A meaningful dose estimation for a single person based on the 200 cells usually analysed is impossible. (auth)

3680 CORRELATION OF THE EFFICIENCIES OF SOME RADIATION SENSITIZERS AND THEIR REDOX POTENTIALS. Simic, M.; Powers, E. L. (Univ. of Texas, Austin). Int. J. Radiat. Biol.; 26: No. 1, 87-90(Jul 1974).

An examination of the relationship between the concentration of a sensitizer at which it was most effective, $(S)_{max}$, and $E^{0\prime}$, the redox potential of the sensitizer at pH7, showed in general a regular inverse relationship between $(S)_{max}$ and increasing $E^{0\prime}$; that is, the higher the oxidative power of the compound studied the more efficient it was as a sensitizer. Four exceptions to this generalisation are discussed, two of which could be explained by the postulated action of two different sensitizing processes. The redox relationship is of practical value, since the concentration of a sensitizer at which it operates most efficiently can be predicted. (UK)

3681 ANTENATAL IRRADIATION AND CHILDHOOD CANCER: CAUSATION OR COINCIDENCE. Mole, R. H. (Medical Research Council, Harwell, Eng.). Brit. J. Cancer; 30: No. 3, 199-208(Sep 1974).

A re-analysis of published data from the Oxford Childhood Cancer Survey shows that the frequency of leukaemia and of solid cancers in childhood is greater following antenatal x-radiography, not only in singleton births but also in monozygotic and dizygotic twins. The radiography rate was 10% in singletons and 55% in twins. A similar excess of leukaemia and of solid cancers in the x-rayed with such different rates of radiography is strong evidence for irradiation as the cause. The low observed frequency of malignant disease in Japanese bomb survivors exposed in utero may not be in serious conflict with this conclusion, as has been supposed. (auth)

3682 PROGENY OF CHILDHOOD - CANCER SURVIVORS. Li, F. P.; Jaffe, N. (National Cancer Inst., Bethesda, MD). Lancet; 2: No. 7882, 707-709(21 Sep 1974).

Inheritance of neoplasms in childhood and genetic effects of tumour therapy were examined in progeny of 46 childhood-cancer survivors, 17 males and 29 females. 107 pregnancies were recorded: 92 (86%) live births, 12 (11%) spontaneous abortions, and 3 (3%) induced abortions. Son/daughter ratio was 20/20 for male patients, and 24/28 for female patients. 2 neonatal deaths resulted from prematurity and 90 have survived. Birth defects in the live born included Hirschsprung's disease in 1, and diverse lesser abnormalities in 13 others. The offspring have been free of cancer and other major chronic diseases. Under conditions of the study, no excess inherited defects were detected. (auth)

3683 RELATIVE EFFECTIVENESS OF SUPER- AND ORTHOVOLTAGE X RAYS FOR INTESTINAL DAMAGE IN MAN AND MOUSE. An Apparent Discrepancy and Its Explanation. Hornsey, S.; Silvester, A. (Hammersmith Hospital, London). Brit. J. Radiol.; 47: No. 562, 670-672(Oct 1974).

The RBE for 8-MV x rays relative to 250-kVp x rays was found to be 1 for damage to the mouse intestinal mucosa measured by jejunal crypt counts. This value was at variance with the RBE of about 0.85 observed for clinical tolerance of patients in irradiation of the abdomen. It was concluded that this difference in RBE observed in mouse and man was due to the overriding importance of changes in depth-dose distribution and of integral dose in the determination of clinical tolerance in man. Only when differences in dose distribution between a new radiation and the reference radiation are minimal can factors obtained from small rodents be applied to man. (auth)

3684 EXTDOS 71: REVISED AND EXPANDED VERSION OF EXTDOS, A PROGRAM FOR TREATMENT PLANNING IN EXTERNAL BEAM THERAPY. van de Geijn, J. (H. Joannes de Deo Hospital, The Hague). Comput. Programs Biomed.; 2: 169-177 (1972).

A description of EXTDØS, was given in a previous issue of this journal. EXTDØS 71 is a large FORTRAN IV program for the computation and display of dose distributions in high energy photon beam therapy. The general policy and structure of the beam model and the program are the same as in EXTDØS. The capabilities have been extended in several directions. The description of the influence of screening blocks has been improved. The correction for inhomogeneities is now included. The program has been reorganized, which resulted in better accessibility and more economical use of core storage. The phenomenon known as overflattening is now accounted for. Optional automatic determination of optimum field widths and weight factors in stationary beam therapy was introduced as a measure of optimization. The influence of certain setting-up errors (during the treatment series) can be simulated. (auth)

3685 VISUAL EFFECTS DURING THE ACTION OF COSMIC RAYS AND HIGH ENERGY PARTICLES ON THE EYE. Demirchoglyan, G. G. (Lab. of Visual Reception, Erevan). Biofizika; 19: No. 2, 314-318(1974). (In Russian).

In order to study direct radiation effects on isolated frog and cricket retinae their surface microcontours were investigated with an electron microscope. On directing an electron ray toward the insect retina a direct stimulation of the photoreceptors was observed. Three hypotheses explaining the flashes observed by astronauts are discussed: that they are a result of Vavilov–Cherenkov luminescence of cosmic ray heavy components, which is contradicted by the fact that visual phosphenes arise from x-rays, not directly from low energy neutrons, and that visual radiophosphenes were also observed by the astronauts under photo-optical conditions, direct stimulation of the retina, and scintillation. Direct stimulation and the damaging effects of the radiation on the external segments of the rod photoreceptors due to either photochemical or nonphotochemical processes is the most probable explanation for the flashes. (JPRS)

3686 PHYSICS AND RADIOTHERAPY. III. Radiation Treatment Technique. Mould, R. F. Nursing Times; 70: 426-428 (21 Mar 1974).

Radiotherapy equipment, radiation dose curves, and factors affecting treatment policy were described in earlier papers. Individual treatment plans are described and illustrated. The particular cancer chosen for most examples is cancer of the cervix. Techniques described include intracavitary therapy, radium tubes, external beam treatment, and the Stockholm technique. The use of Ra, ^{137}Cs, ^{60}Co, and ^{192}Ir is discussed. (HLW)

3687 PHYSICS AND RADIOTHERAPY. IV. Radiation Protection. Mould, R. F. Nursing Times; 70: 468-470(28 Mar 1974).

Radiation protection measures for medical personnel as well as protection of the patient during intracavitary and interstitial therapy are discussed. Protection by means of distance, using remotely controlled hands for loading radiation sources, and by means of lead shields is emphasized. The importance of a bookkeeping system for locating all radium sources in a hospital is pointed out. The use of Geiger counters and personnel monitoring with film badges are also discussed. (HLW)

3688 LATENT RADIATION INJURY OF LUNGS OR HEART ACTIVATED BY STEROID WITHDRAWAL. Castellino, R. A.; Glatstein, E.; Turbow, M. M.; Rosenberg, S.; Kaplan, H. S. (Stanford Univ., CA). Ann. Intern. Med.; 80: No. 5, 595-599(May 1974).

Seven patients with Hodgkin's disease had radiation pneumonitis or radiation-induced heart disease that developed during MOPP (nitrogen mustard, vincristine sulfate (Oncovin), procarbazine, and prednisone) chemotherapy that had been preceded by "mantle" radiation therapy. In all patients the symptoms developed shortly after completion of either cycle 1 or cycle 4 of MOPP, the only cycles in which high doses of prednisone are given. Intervals between radiation and the development of overt radiation injury ranged from a few months to 6 years, without any prior radiographic or clinical suggestion of injury. We believe the rapid withdrawal of high-dose corticosteroids may activate subclinical radiation injury in the lungs or heart. The importance of recognizing this syndrome, which responds to high doses of corticosteroids tapered during many months, is emphasized. (auth)

3689 SPECTROMETRY OF X RADIATION. Panzer, W. (Institut fuer Strahlenschutz, Neuherberg, Ger.). pp 282-283 of Umweltschutz bei Nuklearer und Konventioneller Energiegewinnung. Braun, H. (ed.). Stuttgart; Geog Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

The wide-spread use of x-radiation as a diagnostic tool requires an improved knowledge of the spectral distribution in order to reduce the radiation dose as much as possible. Semiconductor detectors are most frequently used as detectors in the energy range of diagnostic x radiation. The factors to be considered in an evaluation of the x-ray spectra obtained with these detectors are tabulated. (JSR)

3690 LATE EFFECTS OF RADIATION IN MAN AND MAMMALS. Tsuchiya, T. (National Inst. of Radiological Sciences, Chiba, Japan). Radioisotopes (Tokyo); 23: No. 1, 73-86(Jan 1974). (In Japanese).

The late effects of radiation on human beings were defined with 107 references. The etiology of the malignant tumor was histologically observed, and the relationship between the incidence of malignant tumors and radiation doses and dose rate was mentioned. In particular, the problems relating to the disturbance of the growing, the occurrence of the malignant tumors, and the shortening of the life span were discussed as the late effects of radiation upon the fetus and the infant. On the other hand, the late effects of radiation upon the shortening of the life span (promotion of aging) and each organ and tissue (individuals, kidneys, and bone marrows) except the occurrence of malignant tumors were mentioned. Finally, we assumed the mechanism of the late effects as follows. From these results, DNA was disturbed by irradiation. When the cells with mistaken repair or without repair were present, chromosome aberration or mutation was caused. These abnormal cells caused the carcinomatoid cells, or slight different cells from the normal individuals as a cause of self-immunity, and in addition, they changed into carcinogenesis or initiation of aging. These changes were seen in the reproductive or nonreproductive cells. (JA)

3691 COSMIC RADIATION AT HIGH ALTITUDES AND U. S. CANCER MORTALITY, 1950–1969. Mason, T. J.; Miller, R. W. (National Cancer Inst., Bethesda, MD). Radiat. Res.; 60: No. 2, 302-306(Nov 1974).

Data from U. S. death certificates, 1950 to 1969, revealed no excess mortality from leukemia or other cancer in countries with most of their land mass at 3000+ ft elevation or in Denver County or Salt Lake County, which have cities at 5280 and 4390 ft, respectively. (auth)

3692 RATIONALE AND RESULTS OF COMBINATION CHEMOTHERAPY AND CENTRAL NERVOUS SYSTEM IRRADIATION IN ACUTE LYMPHOCYTIC LEUKEMIA. Simone, J.; Pinkel, D. (St. Jude Children's Research Hospital, Memphis). Bibl. Haematol.; No. 39, 1068-1073(1973).

The ultimate goal of a series of studies initiated in 1962 is the permanent cure or, at least, prolonged continuous complete remission of children with acute lymphocytic leukemia. Of 41 patients with previously untreated acute lymphocytic leukemia entered into studies I–III in 1962 to 1965, 37 experienced complete remission; 7 remain in continuous complete remission for 5 years or more and have been off all therapy for 2 to 5 years. Thus, a 17-percent 5-year leukemia-free remission rate was achieved. The durations of complete remission and survival were far superior in the patients who received full-dosage chemotherapy. This indicated that for best results, near-toxic dosages were necessary even when multiple agents were used. Complete remission was most often terminated by CNS leukemia occurring in the presence of hematological remission. The patients in studies I and II received 500 R prophylactic craniospinal ^{60}Co γ irradiation early in remission and patients in study III received 1,200 R. Despite this irradiation, the frequency and duration to relapse in the CNS was not different from that seen in study IV, in which no prophylactic radiotherapy was given. In study V more intensive CNS therapy was given during the first month of remission in hopes of preventing CNS leukemia and prolonging complete remission. This consisted of 2,400 R cranial irradiation and twice-weekly intrathecal methotrexate over 18 days. Of 35 patients who entered this study, 31 attained complete remission. Only 9 patients relapsed; 3 initially in the CNS and 6 initially in the bone marrow. Three patients died of nonbacterial infection during continuous complete remission. Therefore, 19 of the 31 children (61%) who attained complete remission have been in continuous complete remission for 37 to 43 months. Therapy has now been stopped in all these children during the past year. If the same pattern of continuous complete remission seen in the first four studies prevails in study V, a 50-percent 5-year leukemia-free remission rate is expected. A major difference was seen between patients who had received prophylactic CNS irradiation and those who had not Among patients who received prophylactic craniospinal irradiation, only 2 of 45 (4.4%) relapsed initially in the CNS. In contrast, CNS relapse terminated complete remission in 29 of 49 (59%) not given prophylactic craniospinal irradiation. (CH)

3693 RADIATION AND THE HUMAN AGAR COLONY FORMING CELL. Rickard, K. A.; Brown, R.; Kronenberg, H. (Royal Prince Alfred Hospital, Sydney). Pathology; 6: No. 2, 169-181 (Apr 1974).

Studies have been made on certain radiobiological characteristics of the agar colony forming cell (CFC) derived from human bone marrow. Radiation sensitivity expressed as a D_0 value for the human CFC was found to be 127°. No statistical differences were noted in radiation sensitivity of CFC derived from the bone marrow of males or females. For the specimens of bone marrow investigated, a trend was observed towards a negative correlation between their D_0 values and proliferative status, as assessed by kill with radioactive thymidine. The D_0 values for CFC derived from normal and intact marrow populations appeared similar to D_0 values for a population of CFC which contained cells in phases of the cycle other than S. Immediate pre-irradiation of feeder layers did not alter their ability to stimulate and sustain colony growth. (auth)

3694 ANGIOGRAPHY IN RADIATION HEPATITIS. Nebesar, R. A.; Tefft, M.; Vawter, G. F.; Filler, R. M. (Harvard Medical School, Boston). Brit. J. Radiol.; 47: No. 561, 588-593(Sep 1974).

Five cases of surgically and biopsy proven radiation hepatitis were studied by angiography. One case was studied in both the acute and late phases while the remainder were studied only during the late or chronic phase. The angiographic and pathologic findings correlated well. During the acute phase, when hepatic venule obstruction and lobular congestion were present, the angiogram showed enlargement of the affected region with stretching of the hepatic arteries and retrograde (hepatofugal) flow in intrahepatic portal vein branches. In the chronic, recovery phase, there was compensatory hypertrophy of non-irradiated areas with stretching of hepatic arteries and atrophy and fibrosis of the irradiated region which showed crowding and "cork-screwing" of the hepatic arteries with normal hepatopetal portal venous flow. By combining scanning and angiography it would appear that the correct diagnosis could often be suggested. The low probability of metastases could be predicted and re-exploration could thus be avoided with this combined technique especially during the chronic phase of radiation injury. (auth)

3695 EFFECT OF HIGH DOSES OF RADIATION ON HUMAN NEUTROPHIL CHEMOTAXIS, PHAGOCYTOSIS, AND MORPHOLOGY. Holley, T. R.; Van Epps, D. E.; Harvey, R. L.; Anderson, R. E.; Williams, R. C. Jr. (Univ. of New Mexico, Albuquerque). Amer. J. Pathol.; 75: No. 1, 61-72(Apr 1974).

Human neutrophils were exposed to varying amounts of ionizing radiation up to 1,000,000 rad and evaluated as to their ability to respond to chemotactic stimuli and phagocytize and kill bacteria. Striking morphologic and functional resistance to radiation was apparent. At doses up to 5,000 rad there was little or no impairment of chemotaxis. As the dosage increased to 50,000 rad, chemotaxis decreased to approximately 50% of nonirradiated control values. At very high doses of radiation (250,000 to 1,000,000 rad) neutrophils failed to respond significantly to chemotactic stimuli. Effects of radiation as measured by phagocytosis and the degree of ultrastructural change paralleled the chemotaxis results. (auth)

3696 INVESTIGATION OF CYTOGENETICAL ACTIVITY OF RADIOPROTECTORS IN THE CULTURE OF HUMAN LYMPHOCYTES. Arutyunyan, R. M.; Kagramanyan, M. S.; Egiazaryan, S. V. (Erevan State Univ.). Tsitol. Genet.; 8: No. 4, 325-327 (1974). (In Russian).

Influence of radioprotectors: 2-mercaptoethylamine, L-cysteine, 2-amino-ethyl isothiouronium, mexamine, amino-propyl amino-ethylthiophosphoric acid, cystaphos, and unithiol (dithiol 2,3-dimercapto-propansulphate Na) was studied as applied to the culture of human peripheral blood lymphocytes. It is shown that unithiol in a concentration of 10^{-3} M slightly increases the level of chromosomal aberrations in the culture. (auth)

3697 BREAST CANCER FOLLOWING MULTIPLE CHEST FLUOROSCOPY: THE ONTARIO EXPERIENCE. Cook, D. C.; Hewitt, D. (Univ. of Toronto). Can. Med. Ass. J.; 111: No. 5, 406-409; 412(7 Sep 1974).

The hypothesis, derived from experience in Nova Scotia, that artificial pneumothorax, requiring repeated fluoroscopy of the chest, is associated with an increased risk of subsequent breast cancer was tested in Ontario by means of a retrospective cancer patient/control study using record linkage. Sanatorium patients treated by artificial pneumothorax were estimated to have incurred a risk of breast cancer between two and three times as high as that of matched contemporary sanatorium patients treated by other means. There was a tendency for the malignant disease to develop on the side of collapse, and there was evidence of a characteristic latent interval between exposure and onset. (auth)

3698 RADIATION-INDUCED PERICARDITIS IN HODGKINS DISEASE. Marks, R. D. Jr.; Agarwal, S. K.; Constable, W. C. (Univ. of Virginia, Charlottesville). Acta Radiol., Ther., Phys., Biol.; 12: No. 4, 305-312(1973).

In a series of 87 patients who received mediastinal irradiation for Hodgkin's disease, two patients developed pericarditis which was attributed to the radiation therapy. Both patients received 4,000 rad mid-plane tumor dose, one from a cobalt-60 unit to mantle fields treated on alternate days and the second by means of 8 MV roentgen rays utilizing a split course of treatment and treating both fields daily. Employing nominal standard dose determinations, case 1 was shown to have received a heart dose in excess of tolerance, the treatment of one field on alternate days contributing to the excessive dosage. The heart dose in case 2 was within tolerance but acute pericarditis developed within six weeks of radiation therapy. The possibility of individual sensitivity to irradiation is considered. (auth)

3699 NEW CONCEPT OF THE EPA. Lindell, B. (National Inst. of Radiation Protection, Stockholm). Health Phys., 27: No. 3, 324-325(Sep 1974).

Comment is made on a report entitled "Environmental Radiation Dose Commitment: An Application to the Nuclear Power Industry", published by the United States Environmental Protection Agency. It is stated that this report implies that no significant application of the concept of dose commitment to evaluations of the total impact of environmental releases of radionuclides has been reported. However many instances of the use of this concept are cited. (UK)

3700 RADIATION DOSE DISTRIBUTION IN TEMPORAL BONE TOMOGRAPHY. Dahlin, H.; Nylen, O.; Wilbrand, H. (Akademiska Sjukhuset, Uppsala). Acta Radiol., Diagn.; 14: No. 5, 353-367(1973).

The radiation dose distribution to middle and inner ear structures in ototomography was investigated by means of thermoluminescence dosimetry in a phantom and a curve constructed for each individual projection. The doses in patients were estimated with the aid of the dose distribution curve by extrapolation by means of values obtained in the external meatus. The dose values obtained are discussed in the light of previously reported findings. (auth)

3701 APPROACH TO A THEORETIC MODEL FOR THE PROBABILITY OF RECURRENCES IN RADIATION THERAPY. Spring, E.; Paasikallio, K. (Univ. of Helsinki). Acta Radiol., Ther., Phys., Biol.; 12: No. 3, 407-415(1973).

The recurrence phenomenon in radiation therapy was investigated by theoretic models, and approach made to an explanation based on the single-hit, multi-target principle. It seems that the probability of recurrence is highest when the absolute number of cells with one intact target attains its maximum value. A formula is proposed for a recurrence risk dose. (auth)

3702 PHYSICAL AND BIOLOGICAL PARAMETERS OF INTEREST FOR EVALUATING THE POSSIBLE USE OF π-MESONS, NEUTRONS AND CHARGED PARTICLES IN RADIOTHERAPY. Jung, H. (Hamburg Univ. (F. R. Germany). Inst. fuer Biophysik und Strahlenbiologie); Zimmer, K. G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Strahlenbiologie). Roentgen Bl.; 27: No. 8, 381-402(Aug 1974). (In German).

17 figs.; 4 tabs.; 53 refs.

A survey is given of physical and radiobiological parameters relevant with respect to the applicability of the various kinds of radiations for tumor radiotherapy. Distributions of depth dose, linear energy transfer (LET), relative biological effectiveness (RBE), oxygen enhancement ratio (OER), and dose fractionation are discussed for x rays, γ radiation, neutrons, protons, alpha particles, nitrogen ions, and pions. It is shown that negative pions should be especially suitable for radiotherapy of deep-seated tumors. (auth)

3703 DETERMINING RADIATION EXPOSURE FOR THE PATIENT AND THE EXAMINER RADIODIAGNOSTICS. Schmitt, G. (Essen Univ. (Gesamthochschule) (F. R. Germany). Radiologisches Zentrum); Ewen, K. (Zentralstelle fuer Sicherheitstechnik, Strahlenschutz und Kerntechnik der Gewerbeaufsicht des Landes Nordrhein-Westfalen). Roentgen Bl.; 27: No. 8, 403-417 (Aug 1974). (In German).

4 figs.; 14 tabs.; 27 refs.

The problems of individual dosimetry for patient and examiner have assumed additional importance through the X-Ray Ordinance of 1973, particularly regarding recording requirements. Determining gonad and lens doses presents no particular measurement problems. In contrast, it is quite difficult to specify the radiation absorption of larger body sections. While the integral dose is the appropriate determination size, this is hardly measurable in practice. Therefore, it has to be replaced by more accessible sizes. This may be: (1) the dose-surface product, (2) the formula given by Mayneord, which requires the surface doses, the surface area at the ray entrance, the tissue half-value depth, and the focus-skin distance. The integral dose can pertain to the whole body (entire body dose), or also to specific organs (for example, bone marrow dose). The critical dose values of integral doses, bone marrow integral doses, gonad and lens doses are discussed using numerous examples. (auth)

3704 SIGNIFICANCE AND AIMS OF RADIATION HYGIENE. Stieve, F. E. (Bundesgesundheitsamt, Berlin (F. R. Germany). Abt. fuer Strahlenhygiene). Aerztl. Praxis; 25: No. 66, 2890-2891(Aug 1973). (In German).

A definition of the term "radiation hygiene" is given. The tasks of the German Federal Health Office in this field are outlined. (GE)

3705 RADIATION DOSES FROM HYPOTHETICAL EXPOSURES TO COMBUSTION PRODUCTS OF PLOWSHARE GAS DISCHARGED FROM STACKS. Moore, R. E.; Barton, C. J. (Oak Ridge National Lab., TN). Nucl. Technol.; 24: No. 2, 238-245(Nov 1974).

Whole body annual radiation doses to man due to tritium were estimated for hypothetical exposures to stack gases discharged from the Cherokee Steam Electric Station in the Denver area burning 94 million ft^3/day of nuclearly stimulated natural gas containing 10 pCi/cm^3 of tritium. The highest dose that might be received by any person outside the plant area was estimated to be 0.006 mrem/yr, using annual average weather data. This predicted dose includes 0.005 mrem/yr from the initial exposure to plumes from the stacks, and 0.001 mrem/yr estimated for exposures to residual tritium repeatedly swept over the area by wind reversals which occur almost daily in the Denver area. The total dose to the nearby population of 1.55 million people was estimated to be 3.0 man-rem/yr, of which 1.6 man-rem/yr are attributable to the initial plume exposure, and the balance is from exposures due to wind reversals. (auth)

Vertebrates

Refer also to abstracts 3628 and 3766.

3706 (SAN−899X2) DIRECT, LONG-TERM OBSERVATION OF HEMATOPOIETIC MARROW. Annual Report, 15 July 1973−14 July 1974. (Scripps Clinic and Research Foundation, La Jolla, Calif. (USA)). 1974. Contract AT(04-3)-899. 9p. Dep. NTIS $4.00.

Progress is reported on the following research projects: suppression of bone formation following extramedullary marrow implantation into whole-body irradiated mice; sensitivity of regenerating splenic tissue of rats to gamma radiation; characterization of bone marrow adipose cells; delivery of mature cells into circulation; histochemistry and cytochemistry; and frozen marrow storage. (HLW)

3707 EFFECTIVENESS OF CONTINUOUS LOW DOSE-RATE GAMMA-IRRADIATION ON RAT SKIN. Kal, H. B.; Sissingh, H. A. (Radiobiologisch Instituut TNO, Rijswijk, Netherlands). Brit. J. Radiol.; 47: No. 562, 673-678(Oct 1974).

A skin transplantation technique was employed for assessment of radio-induced damage to rat skin. Shrinkage of the area of an irradiated piece of white skin was measured five months after transplantation onto brown F_1 hybrid rats. The effectiveness of ^{137}Cs γ rays at a dose-rate of 85 rads/hour was compared with that of 300-kV x rays applied at 40 rads/minute. Protracted irradiation provided a large sparing effect due to repair of sublethal damage. For a 90% reduction of skin area, the ratio of the doses given at low and high dose-rate, respectively, was 1 : 8. Comparison of these results with data obtained previously for a rat rhabdomyosarcoma, indicated that protracted irradiation at low dose-rate, when compared with acute irradiations, had a larger sparing effect on skin than on the tumour. (auth)

3708 COLORIMETRIC INVESTIGATION OF THE ACTION OF IONIZING RADIATION ON ISOLATED FROG SKIN. Sanaya, T. V. pp 515-518 of Sixth All Union Conference on Colorimetry. Tbilisi, USSR; Metsniereba (1973). (In Russian).

Comparison of the results of colorimetric studies with the curve of the differences of electric potentials (DEP) of the frog skin shows that there exists a sufficiently close correlation between the data obtained by these two methods. On the curves characterizing relative changes of heat capacity, as well as on the DEP curves two maxima are observed. However, the change in the DEP of frog skin begins at 20°, while the change in the relative heat capacity begins to be observed from 37° and higher. Evidently initial changes of the DEP are not connected with structural changes in the skin. (auth)

3709 RADIATION-PROTECTING EFFECTS OF VARIOUS COMBINATIONS OF PANTOTHENIC ACID, AMINOETHYLISOTHIURONIUM AND CYSTEAMINE. Gazdagh, I.; Szegszardy, T.; Szorady, I.; Erostyak, M. (Ajka Municipal Council Hospital, Szeged, Hungary). Kiserl. Orvostud.; 26: No. 1, 66-69(Feb 1974). (In Hungarian).

Male mice weighing approximately 20 grams were irradiated with and without prior administration of aminoethylisothiuronium, calcium panthotenate, cysteamine, and various combinations of these. Radiation doses of 600 and 900 R were employed, using a TUR 250 instrument equipped with Cu filter. The survival rates of the test-animal groups after the various treatments and irradiations were measured. The radiation-protection capability of panthotenic acid and aminoethylisothiuronium in combination was already reported; the present studies indicated clearly that combination of these two agents with cysteamine is even superior in this respect. (JPRS)

3710 EFFECT OF 50 MeV PROTONS ON TESTES OF MICE. Fedorenko, B. S.; Kondratenko, V. G.; Stakanov, V. A.; Bairakova, A.; Babaev, I.; Khlaponina, V. F. Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 6, 16-19(1974). (In Russian).

The biological effect of 50 MeV protons and ^{60}Co gamma rays on testes of mice has been studied pathomorphologically, cytogenetically, and cytofluorimetrically. The results show that both types of penetrating radiations in similar dosages induce analogous responses and pathological processes. The dose dependence of cytogenetic effects and nuclear changes in spermatogenic cells has been revealed at a later stage of research. These changes have been followed by weakly pronounced pathomorphological disorders. As compared to gamma-irradiation, protons with an energy of 50 MeV demonstrate a lesser biological effectiveness. (auth)

3711 MODIFICATION OF THE CYTOGENETIC EFFECT OF IONIZING RADIATION DURING AN EXPOSURE TO CONSTANT MAGNETIC FIELDS. Galaktionova, G. V.; Strzhizhovskii, A. D. Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 6, 25-28(1974). (In Russian).

The modifying effect of the constant magnetic field of 1000 to 4500 oersted on the postradiation changes in the mitotic index and the frequency of aberrant mitoses in corneal epithelial cells of mice was studied. A three-hour exposure to the constant magnetic field of 4500 oersted immediately before or after irradiation with a dose of 400 rads affected insignificantly the cytogenetic effect of ionizing radiation. A five-day exposure of animals to the constant magnetic field of 1000 oersted after irradiation produced no modifying influence on the radiation effect. An irradiation of mice after their 15-day exposure to the constant magnetic field of 1000 oersted did not alter the postradiation inhibition of mitotic activity and increased the level of its recovery. This effect also reduced the yield of irradiation induced chromosome aberrations and brought about no substantial changes in the rate of their elimination. (auth)

3712 DEVELOPMENT OF TUMORS IN DOGS EXPOSED TO LOW DOSES OF GAMMA IRRADIATION FOR A LONG TIME. Yakovleva, V. I. Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 6, 20-24(1974). (In Russian).

During 6 years, 150 animals were exposed to a chronic (with a dose of 21, 63, and 125 rads per year and a dose rate of 0.06, 0.17, and 0.34 rads per day, respectively) and combined (chronic irradiation with a dose of 63 rads per year and acute irradiation with a dose of 58 and 126 rads per year) gamma irradiation. An autopsy of 74 irradiated animals demonstrated malignant neoformations (flat-celled lung cancer, hepatocellular liver cancer, skin basalioma, osteogenic rib sarcoma, and eye melanoma) in five dogs, benign neoformations (three leidigomas, parenchymatous struma of the thyroid gland, and angiofibroma of subcutaneous connective tissue) in five animals. An examination of 19 control dogs showed mammary tumors (cystadenoma and adenofibroma developing into adenocarcinoma) in two animals. The greatest number of neoformations was found in the animals that were exposed to a chronic irradiation with the highest dose rate and in the animals that received the highest total doses during chronic irradiation. (auth)

3713 RESULTS AND PROBLEMS OF RADIOGENETICS IN MAMMALS. Ehling, U. H. (Gesellschaft fuer Strahlen- und Umweltforschung, Neuherberg, Ger.). pp 289-291 of Umweltschutz bei Nuklearer und Konventioneller Energiegewinnung. Braun, H. (ed.). Stuttgart; Geog Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

The development of methods for determining recessive mutations, dominant vital mutations, and dominant lethal mutations in the mouse is summarized. (JSR)

3714 DAILY RHYTHM OF IRON CONTENT OF THE SPLEEN AFTER X IRRADIATION. Mozdzan, M.; Pierscinski, A. (Jagiellonian Univ., Krakow). Folia Biol. (Krakow); 22: No. 3, 304-308(1974).

Iron was assayed by the histochemical method in the spleens of mice irradiated with a single lethal dose of x rays (2100 R). In comparison with controls, the concentrations of iron showed distinct changes characterized by a daily rhythm. The spleens were secured for examination at 6-hour intervals (12:00, 18:00, 24:00, and 6:00 hr) during three consecutive days after irradiation. In the control group, the iron levels showed a weakly expressed rhythm, and in the irradiated group iron levels were increased, with distinct maxima in the night hours (24:00 hr), declining gradually in the daytime. (auth)

3715 EFFECT OF LETHAL DOSES OF X RADIATION ON CONDITIONED ACTIVITY OF RATS OF DIFFERENT AGES. Kharchenko, P. D.; Chaichenko, G. M.; Elmuratov, S. (Kiev State Univ.). Zh. Vyssh. Nerv. Deyateln. im. I. P. Pavlova; 24: No. 2, 279-286(1974). (In Russian).

The influence of total irradiation (700 R) on the basic parameters of conditioned activity was studied in young (three to four months), adult (seven to eight months), and old (18 to 24 months) male white rats. Irradiation deteriorated the conditioned activity in all the age groups, as manifested in longer latency and duration of the conditioned reflex, a depression of the animals activity and a disturbance in differentiation inhibition. The direct effect of irradiation was expressed in lower efficiency of the motor reaction in young and old animals and a depression of general motor activity in the adult animals. Subsequently the rats of all age groups exhibited for a long time a low efficiency of the conditioned motor reaction, with considerable fluctuations, notably in the old rats. The effect of irradiation is above all manifested in a weakening of internal inhibition processes. (auth)

3716 ENERGY TRANSFER IN HETEROCYCLIC IODONIUM COMPOUND FOR PROTECTION AGAINST IONIZING RADIATION. Liu, L. S.; Tung, C. T.; Cheng, J. L. (Lanchow Univ., China). K'o Hsueh T'ung Pao; 19: No. 6, 274-277(15 Jun 1974). (In Russian).

A study was made on the protective action and mechanism of four heterocyclic iodonium compounds against ionizing radiation. It was found that 3,6-di-dimethylamine diphenyliodopyranoid acetate gives the best protection in mice, and that, on the basis of fluorescent intensity, broader conjugated system, stronger electron ejection effect as well as weaker electron absorption effect correspond to higher quenching of radiation excitation. It is concluded that the broader conjugated system of such type of drugs actually takes away the excitation energy of radiation from the biological macromolecules, and thus protects the organs from radiation injury. (JPRS)

3717 RECOVERY FROM RADIATION-CARCINOGENIC INJURY TO THE MOUSE OVARY. Yuhas, J. M. (Oak Ridge National Lab., TN). Radiat. Res.; 60: No. 2, 321-332(Nov 1974).

The induction of ovarian tumors in BALB/c female mice exposed to graded doses of ^{137}Cs gamma rays (49 to 392 rads) at rates of 1.75, 3.5, 7, 14, 28, 56, and 112 rads/day was studied. The incidence of ovarian tumors was an increasing function of both total dose and dose rate or, stated in alternate terms, a decreasing function of exposure time. The incidence varied as the second power of the dose (2.0 ± 0.16), when exposure time was held constant, demonstrating that the dose–response curve for this cancer cannot be linear. The incidence was inversely related to the 0.69 power of the exposure time, and approximately one-third of this exposure time factor resulted from age-dependent loss of sensitivity. The remaining two-thirds of the overall exposure time factor is presently under study and is concluded to be the product of both intra- and intercellular recovery. (auth)

3718 EFFECTS OF RADIATION ON BONE FORMATION: A FUNCTIONAL ASSESSMENT. Morse, B. S.; Giuliani, D.; Giuliani, E. R. (New Jersey Medical School, Newark). Radiat. Res.; 60: No. 2, 307-313(Nov 1974).

A reduction of estrone-induced endosteal bone formation was noted in the tibia of mice locally x-irradiated with doses in excess of 900 R. When estrone injections were started 4 days postirradiation, increased bone formation was noted between 300 and 900 R. As the dose of radiation was increased above 900 R, there was a progressive impairment of the response to estrone injections. Bone formation, though substantially reduced, was still demonstrable after 2220 R. Little recovery was noted over a 7-mo period following this dose. A functional separation of hemopoietic and osteogenic precursor cells was achieved; the former displayed greater radiosensitivity than the latter. (auth)

3719 CRYPTOGENIC CELLS AND PROLIFERATIVE CELLS IN INTESTINAL EPITHELIUM. Hendry, J. H.; Potten, C. S. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol.; 25: No. 6, 583-588(Jun 1974).

The number of cells in the mouse intestinal crypt that are capable of crypt regeneration after radiation damage was estimated to be 44^{+20}_{-14}, which was less than the known number of about 135 proliferating cells. A correction was considered necessary to measurements of crypt survival by the technique of microcolony assay to allow for the increase in the size of regenerating crypts. (auth)

3720 DOUBLE MINUS LOG TRANSFORMATION OF MORTALITY PROBABILITIES. Gilbert, W. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol.; 25: No. 6, 633-634(Jun 1974).

A method of plotting the mortality probability of an organism versus dose, so that the survival characteristics of sensitive cells may readily be deduced, is described. The possibility of other applications of the double minus log plot method outside the radiation field is suggested, and an example is given using published data for the fraction of non-takes after injections of various tumor cells (a dilution technique). (UK)

3721 RESPONSE OF RAT THYROID, A HIGHLY DIFFERENTIATED TISSUE, TO SINGLE AND MULTIPLE DOSES OF GAMMA OR FAST NEUTRON IRRADIATION. Malone, J. F. (Univ. of Glasgow); Hendry, J. H.; Porter, D.; Greig, W. R.; Halnan, K. E. Brit. J. Radiol.; 47: No. 561, 608-615(Sep 1974).

The RBE for 14.7-MeV neutron radiation in the thyroid, a highly differentiated tissue, was found to be 1.8 relative to ^{137}Cs radiation at the 10% survival level. Absolute dosimetry errors were 5% for 14.7-MeV neutron irradiations, and 3% for ^{137}Cs irradiations. The index used was cell survival as estimated from goitrogen-induced cellular proliferation. Under fractionated conditions the RBE increased to 3.0. The relevance of these findings to clinical radiotherapy is discussed. (auth)

3722 RADIATION-INDUCED NONDISJUNCTION IN MOUSE OOCYTES. Uchida, I. A.; Lee, C. P. V. (McMaster Univ., Hamilton, Ont.). Nature (London); 250: No. 5467, 601-602(16 Aug 1974).

It is stated that chromosomal trisomy is found with relatively high frequency in congenital malformations and spontaneous abortions in the human species, and that one possible factor is exposure of women to diagnostic x rays. Experiments with Drosophila melanogaster have indicated that nondisjunction can be induced by exposure of females to x rays, especially if the flies are old. Advances in the technique for culturing mouse oocytes in vitro have made it possible to examine meiotic chromosomes in second metaphase, and the experiments described were designed to study the effect of low doses of whole-body irradiation on chromosome segregation during the first meiotic division in the oocytes of young female mice. The mice were exposed to 10 R, 20 R, and 30 R ^{137}Cs γ-irradiation at a rate of 29 R/min. The dosage was kept low to minimize chromosome breakage. Full experimental details are given. Some of the irradiated oocytes had an extra chromosome, making 21 in all. The total frequency of nondisjunctional events was estimated to be approximately double the number of oocytes with 21 chromosomes. It was concluded that nondisjunction can be induced in young female mice by exposure in vivo to low doses of radiation. (UK)

3723 REDUCTION BY ANTI-INFLAMMATORY CORTICOSTEROIDS OF CLONOGENIC GROWTH OF ALLOGENEIC TUMOUR CELLS IN NORMAL AND IRRADIATED TISSUES OF THE RAT. Van den Brenk, H. A. S.; Kelly, H.; Orton, C. (Saint Thomas Hospital, London). Brit. J. Cancer; 29: No. 5, 365-372 (May 1974).

Anti-inflammatory corticosteroids administered to rats in high dosages before intravenous injection of allogeneic tumor cells caused 5 to 10 fold reductions in "take" and clonogenic growth of the cells in lung and kidney and decreased growth and spread of the cells transplanted to leg muscle. Steroid therapy also reduced the effect of local irradiation of lung tissues in increasing tumor colony efficiency (CFE) in the lungs; it also tended to reduce similar effects of sublethal whole body irradiation. A non-steroidal anti-inflammatory drug, phenylbutazone, also reduced CFE in locally irradiated lungs in the rat. The results obtained indicate that corticosteroids do not stimulate the growth of implanted tumor cells by suppressing host immunity but decrease their clonogenic growth by inhibiting local inflammatory reactions to cell arrest, and similarly to local tissue damage caused by x-irradiation; it is asserted that such inflammatory reactions are growth promoting and thereby stimulate regeneration of stroma (repair) and also support survival and early growth of the tumor cell. (auth)

3724 IMMUNITY TO MURINE SARCOMA VIRUS INDUCED TUMORS. III. Analysis of the Cell Populations Involved in Protection from Lethal Tumor Progression of Sublethally Irradiated, MSV Inoculated Mice. Gorczynski, R. M.; Norbury, C. (University Coll., London). Brit. J. Cancer; 30: No. 2, 118-128(May 1974).

A comparison was made between the cells responsible for demonstrable activity against MSV antigens, using both in vivo and in vitro assays. Similar cells (in terms of size and sensitivity to anti-theta serum) were detected in both assays. However, while lymphoid cells from animals at all stages post-MSV infection were active in protecting irradiated mice from the lethal effect of induction of MSV sarcomata, cells from animals at early stages post-MSV infection (when the tumor was in a progressive phase of growth) were not active in the in vitro assay. By manipulation of the in vivo assay conditions a situation was observed in which cells from "progressor animals" were able to suppress both the in vitro and in vivo activity of regressor lymphoid cells. The potential physiological role of this cell is discussed. (auth)

3725 RESPONSE OF WHOLE-BODY IRRADIATED MICE TO INOCULATION OF THEILERIA PARVA-INFECTED BOVINE LYMPHOID CELLS. Irvin, A. A.; Brown, C. G. D.; Kanhai, G. K.; Kimber, C. D.; Crawford, J. G. (East African Veterinary Research Organization, Kabete, Kenya). J. Comp. Pathol.; 84: No. 3, 291-300(Jul 1974).

Theileria parva-infected bovine lymphoid cells produced tumor-like masses at the site of subcutaneous inoculation in Swiss mice that were whole-body irradiated with ^{60}Co γ radiation. The optimal dose range for irradiation was 800 to 900 rad. Intact parasitized cells were detected in these masses up to about day 17 after inoculation and were then gradually rejected as the host's defence mechanisms recovered. The masses appeared to be produced by the continued growth of tissue culture in the immunosuppressed host. There was no evidence that mouse cells became parasitized. (auth)

3726 LETHAL EFFECTS OF 3000 MHz RADIATION ON THE RAT. Schrot, J.; Hawkins, T. D. (Walter Reed Army Inst. of Research, Washington, DC). Radiat. Res.; 59: No. 2, 504-512(Aug 1974).

Rats were exposed for short durations (30, 60, 120, and 240 sec) to electromagnetic irradiation at a frequency of 3000 MHz. At each duration of exposure percent mortality increased with increases in incident energy density (power density × duration). The incident energy density required to kill 50% (LD$_{50}$) increased monotonically with increasing exposure durations. Lethal power density (LD$_{50}$) was a decreasing monotonic function of exposure duration. In addition, body weight was found to be a factor in determining mortality. (auth)

3727 RELATIVE BIOLOGICAL EFFECTIVENESS OF FAST NEUTRONS FOR SPINAL CORD INJURY. Geraci, J. P.; Thrower, P. D.; Jackson, K. L.; Christensen, G. M.; Parker, R. G.; Fox, M. S. (Univ. of Washington, Seattle). Radiat. Res.; 59: No. 2, 496-503(Aug 1974).

The interval between x irradiation of the lumbar spinal cord of mice and the onset of hindquarter paralysis was observed to be inversely related to the amount of radiation administered. Using the length of latent period as an endpoint, the fast neutron RBE for spinal cord damage as a function of neutron dose was measured. This RBE for spinal cord injury was observed to be close to unity for high neutron doses in the range of 1700 to 4500 rad and appeared to increase with decreasing neutron dose. Histological examination of neutron and x irradiated spinal cords revealed necrosis of white and grey matter and the spinal nerve roots. Vascular damage also was evident in a large percentage of neutron and x irradiated spinal cords. (auth)

3728 DISTRIBUTION OF WR-2721 IN NORMAL AND MALIGNANT TISSUES OF MICE AND RATS BEARING SOLID TUMORS: DEPENDENCE ON TUMOR TYPE, DRUG DOSE AND SPECIES. Washburn, L. C. (Oak Ridge Associated Universities, TN); Carlton, J. E.; Hayes, R. L.; Yuhas, J. M. Radiat. Res.; 59: No. 2, 475-483(Aug 1974).

S-2-[3-Aminopropylamino]ethylphosphorothioic acid (WR-2721) preferentially protects the normal, as opposed to the malignant, tissues of tumor-bearing mice from radiation injury. The major factor responsible for this difference in response appears to be the relatively poor absorption of the drug by the tumor. In order to determine whether deficient drug absorption was characteristic of solid tumors and to extend the study of the absorption patterns to the problems that might be encountered in clinical radiotherapy, normal and tumor tissue concentrations of ^{35}S-labeled WR-2721 were determined 30 min after injection of graded doses of the drug (1, 50, 100, or 300 mg/kg) in two species (mice and rats) bearing 4 different solid tumors (P-1798 lymphosarcoma and CA-755 adenocarcinoma in mice and the RFT tumor and Morris 7777 hepatoma in rats). It has been demonstrated that: (1) 3 of the 4 tumors studied evidenced deficient drug absorption, but the Morris 7777 hepatoma absorbed WR-2721 as readily as the host's normal tissues; (2) the relative concentration of the drug in normal and tumor tissues was independent of the injected dose between 50 and 300 mg/kg; (3) the injection of tracer levels of WR-2721 (1 mg/kg) can be used to identify those tumors that show a deficient absorption, but not to quantitate the degree of this deficiency; and (4) the relationship between the injected dose and tissue concentration, after correction for species differences in surface area, was species independent for the lungs, small intestine and spleen, but species dependent for kidney and liver. It was concluded therefore that WR-2721 is a promising agent for increasing the efficiency of solid tumor radiotherapy, but that each tumor must be considered individually. (auth)

3729 MORTALITY RESPONSE OF GOLDFISH AFTER EXPOSURE TO FAST NEUTRONS. Etoh, H.; Hyodo-Taguchi, Y.; Maruyama, T. (National Inst. of Radiological Sciences, Chiba, Japan). Radiat. Res.; 59: No. 2, 513-520(Aug 1974).

The mortality response of goldfish to whole-body irradiation with 2 MeV fast neutrons from a Van de Graaff accelerator was studied and compared with the effects of 200 kVp x rays. Although the dose ranges leading to equivalent injury were different with the two types of radiation, the dose vs survival time relationship, and the distribution pattern of time of death after irradiation with fast neutrons were similar to those observed after x irradiation. Mean lethal dose was used to determine the relative biological effectiveness of neutrons. The LD$_{50(30)}$ was 375 rad for neutrons and 1238 rad for x rays, from which the RBE of neutrons was calculated to be 3.4. The histological changes in hematopoietic tissue (body kidney) and intestine to 400 or 1000 rad of neutrons were examined. In fish irradiated with 400 or 1000 rad of neutrons, the marked reduction in the number of hematopoietic cells occurred 5 to 10 postirradiation days. Severe lesions in the intestine were observed only in 1000 rad-irradiated fish at 10 days after irradiation. These results were compared with previous x irradiation results in fish. (auth)

3730 LATE EFFECTS OF IRRADIATION ON THE THYROID GLAND IN MICE. III. Comparison Between Irradiation of Fetuses and Adults. Walinder, G.; Sjoeden, A. M. (Foersvarets Forskningsanstalt, Stockholm). Acta Radiol., Ther. Phys., Biol.; 12: No. 3, 201-208(1973).

The thyroid glands of mice born within the course of one week were irradiated (a) at the fetal stage, by intravenous injections of ^{131}I solutions to the mothers on the 18th day of gestation, by whole-body roentgen exposure, or by a combination of the two forms of radiation, or (b) as adults, by intraperitoneal injections of ^{131}I. In 109 1-year-old mice exposed in utero to 7,800 rad from ^{131}I (to the central parts of the glandular lobes), three benign and four malignant thyroid tumors were observed. No thyroid tumors could be found in 91 1-year-old animals exposed to 8,500 to 9,500 rad from ^{131}I at 3 months of age. (auth)

3731 ELECTRON IRRADIATION OF MONKEY SKIN. Lippincott, S. W.; Montour, J. L.; Wilson, J. D. (Virginia Commonwealth Univ., Richmond). Acta Radiol., Ther., Phys., Biol.; 12: No. 4, 347-352(1973).

Nineteen rhesus monkeys were irradiated with low energy monoenergetic and spectral electrons simulating conditions as they exist in the outer belt and the equatorial synchronous orbit. A correlation of the early pathologic responses in the skin was made with reference to depth-dose pattern, size of area involved, and post-irradiation observation periods. The lowest dose producing erythema was 900 rad by five days and for ulceration 1,450 rad at fourteen days. (auth)

3732 EFFECT OF RADIOPROTECTIVE DRUGS ON THE THERAPEUTIC RATIO FOR A MOUSE TUMOR SYSTEM. Lanny, R. O.; Baker, D. G. Acta Radiol., Ther., Phys., Biol.; 12: No. 3, 425-433(1973).

The radioprotective agents, cysteamine and WR-2721, combined with radiation therapy, improved the therapeutic ratio in treatment of the KHT sarcoma implanted in the thigh of C3H/HeJ mice. Tumor control in 50 per cent of the unprotected animals required 5,600 rad in two fractions, while the cysteamine protected animals required 7,500 rad and WR-2721 protected animals 6,900 rad. The protective action of the agents on the acute skin reaction was investigated through similar fractionated courses of irradiation. The therapeutic ratio, the relationship of the tumor lethal dose to the tissue tolerance dose, was found to have been increased by 30 per cent for cysteamine and 60 per cent for WR-2721. (auth)

3733 ORIGIN OF RADIATION RELEASED SEROTONIN IN RABBITS AND MICE. Veninga, T. S.; Kerkstra, J.; Wagenaar, J. (State Univ., Groningen, Netherlands). Acta Radiol., Ther., Phys., Biol.; 12: No. 3, 454-464(1973).

Blood plasma levels of free 5-hydroxytryptamine (serotonin, 5-HT) have been determined in rabbits and mice following zonal roentgen irradiation of the animals to identify the source of the 5-HT released. The results indicated the intestinal tract as the most probable site from whence the 5-HT was originating. Further investigation of the liberation as a potential indicator of radiation injury in the abdominal region would appear to be required. (auth)

3734 EFFECT OF ROENTGEN IRRADIATION ON MONOAMINE, CONTAINING NEURONS IN THE RAT BRAIN. Dahlstroem, A.; Haeggendal, J.; Rosengren, B. (Univ., Goteborg). Acta Radiol., Ther., Phys., Biol.; 12: No. 3, 191-200(1973).

The effect of local 4,000 R irradiation of the head on central monoaminergic neurons in the rat brain was investigated histochemically and biochemically by fluorescence. The irradiation damage was detected only by histochemical methods, demonstrating that the total content of brain monoamine may be essentially unchanged in spite of leakage of the amines from the terminals. Salivary glands presented a marked decrease in total nucleic acids by 7 days but no clear histochemical differences. (auth)

3735 ENTERAL SODIUM AND FLUID TRANSPORT BEFORE AND AFTER RADIATION EXPOSURE. Physiological Investigations on the Intestine of Awake Rats. P. 2. Large Intestine. Herzer, R. (Tuebingen Univ. (F. R. Germany). Medizinisches Strahleninstitut und Roentgenabteilung). Strahlentherapie; 147: No. 6, 649-659(Jun 1974). (In German).
2 figs.; 6 tabs.; 7 refs.

Under the application of a special examination technique (extracorporeal perfusion of the intestine of awake, nonnarcotized rats) the transport of sodium and water under the influence of ionizing radiation was investigated in the colon. The experiments were made after different radiation doses (500, 1,000, and 1,500 R), various intervals after exposure (12 to 16 and 36 to 40 hours) as well as with various osmolar fluids for the perfusion (water, 0.9 and 1.8% salt solutions). The functional behaviour of the colon under the cited conditions showed significant deviations from comparative examinations on the small intestine (Strahlentherapie 147 (1974), 531). The net volume transport under perfusion with water, in contrast to the jejunum, brought an increase of the fluid resorption up to 1,000 R and until about 40 hours after the irradiation was terminated. The net transport of sodium after perfusion of the colon with a hyperosmotic salt solution was similar and likewise obviously different from the small intestine. The clear tendency of the upper small intestine to reach a stagnation or reversion of the transport motions via a decrease of the transport rates, in correlation to time and radiation dose, was seen much later and less intensive on the large intestine, according to the lower radiation sensibility of the region. The statistic examination of the isolated influence of dose and interval and their reciprocal effect on the results showed, in contrast to the small intestine, a slight predominance of the dose. (auth)

3736 EFFECT OF CERTAIN RADIOPROTECTIVE COMPOUNDS ON POSTRADIATIONAL SODIUM METABOLISM. Drodz, S. S.; Burlakova, E. V.; Burdin, K. S. (Moscow State Univ.). Biol. Nauki; No. 2, 47-51(1974). (In Russian).

The distribution of ^{22}Na in the liver of mice irradiated with 720 R of x radiation at a dose rate of 33 R/min was studied by the liquid scintillation method for the determination of the radioisotope. The mice received AET, pyridine, pyridine N-oxide, 2,6-lutidine N-oxide, AET + pyridine, AET + pyridine N-oxide, or AET + 2,6-lutidine N-oxide before the irradiation. In the irradiated animals not receiving the radioprotective compounds, a sharp increase in the quantity of ^{22}Na in the liver was produced. The introduction of the radioprotective compounds slowed down the accumulation of ^{22}Na in the liver tissues of the irradiated animals. (tr-auth)

3737 ENERGY METABOLISM IN THE MYOCARDIUM OF RATS IN ACUTE RADIATION SICKNESS OF VARYING DEGREE OF SEVERITY. Movsesyan, M. A.; Arutyunyan, D. E. (Inst. of Roentgenology and Oncology, Erevan). Zh. Eksp. Klin. Med.; 13: No. 3, 9-15(1973). (In Russian).

On the basis of a study of the quantity of ATP, creatine phosphate, and the activity of the ATP-ase and from a determination of the process of oxidizing phosphorylation by the polarographic method, it was concluded that during acute radiation sickness metabolism in the myocardium of rats shows no impairment and the apparently insignificant changes are not the causes of the appearance of myocardial-vascular insufficiency. (tr-auth)

Invertebrates

Refer also to abstract 3657.

3738 EFFECT OF REARING MEDIA ON THE SUSCEPTIBILITY OF RUST RED FLOUR BEETLE, TRIBOLIUM CASTANEUM (HERBST) TO GAMMA RADIATION. Bhatia, P.; Sethi, G. R. (IARI, New Delhi). Indian Soc. Nucl. Tech. Agr. Biol., Newslett.; 2: No. 1, 30-32(1973).

Susceptibility of T. castaneum adults reared on 5 food media viz., wheat, jowar, barley, maize and bengal gram flour to gamma radiation was studied. The LD$_{50}$ values based on mortality observed 12 days after irradiation ranged from 4206 rads for beetles reared on bengal gram to 9826 rads for those reared on jowar. On the basis of LD$_{50}$ values, the relative susceptibility of beetles reared on these foods was bengal gram > barley > maize > wheat > jowar. Delayed response to irradiation (8000 rads) as indicated by TD$_{50}$ values also showed that insects reared on bengal gram were more susceptible than those obtained from other media. On the basis of lower adult emergence and prolonged development period, bengal gram was found to be much inferior food as compared to the rest. (Indian Sci. Abstr.)

3739 EFFECT OF GAMMA RADIATION ON THE FEEDING, MOLTING, AND OVIPOSITION OF HAEMAPHYSALIS LONGICORNIS. Fujisaki, K.; Kitaoka, S.; Morii, T. (National Inst. of Animal Health, Tokyo). Norinsho Kachiku Eisei Shikenjo Kenkyu Hokoku; No. 68, 12-20(Mar 1974). (In Japanese).

Gamma rays in the range of 125 to 4,000 rad were given to amphigenetic H. longicornis in each growing period, and the effects of the radiation on blood-sucking, metamorphosis-molting, and oviposition were observed. In each growing period, ticks which do not suck blood yet were more sensitive to γ rays than blood-sated ticks. The metamorphosic rate of young ticks which do not suck blood yet was reduced and metamorphosic time was extended by 2000 rad irradiation, while metamorphosis and molting did not occur with 4000 rad. Blood-sated body weight and blood-sucking days were not affected by radiation period and dose. The blood-sucking and oviposition of the adult tickets metamorphosed after receiving irradiation in young tick period in blood-sated state were remarkably inhibited as compared with those irradiated in adult period in the state that blood had not been sucked. The oviposition rate and hatching rate of irradiated female ticks were about the same as those in the case where both male and female were irradiated. This fact shows that the influence of the irradiated male ticks on the growth of eggs through insemination was less than the influence of the directly irradiated female. (JA)

3740 RADIATION DISINFESTATION OF CEREAL INSECTS. III. Radiosensitivity of Plodia Interpunctella. Takano, H.; Umeda, K. (National Food Research Inst., Tokyo). Nippon Shokuhin Kogyo Gakkaishi; 21: No. 6, 267-272(Jun 1974). (In Japanese).

Investigations were carried out on the use of cobalt-60 gamma irradiation for Indian meal moth, Plodia interpunctella, which is one of the main cereal insects in Japan. Eggs, larvae, and pupae were irradiated at each stage and held until emergence was complete. Then LD$_{99}$ and LD$_{50}$ values were determined from curves on the probit scale. The LD$_{99}$ values required to prevent hatching of 0 day old eggs and 2 days old eggs were 2.75 Krad and 35 Krad, and the LD$_{50}$ values were 1.5 Krad and 22 Krad, respectively. The LD$_{99}$ and LD$_{50}$ values required to prevent adult emergence were 1.2 Krad and 0.6 Krad for 0 day old eggs, 5.6 Krad and 3.3 Krad for 2 days old eggs, 8.3 Krad and 4.5 Krad for first instar (7 to 10 days old) of larvae, 9.2 Krad and 5.3 Krad for last instar (30 to 33 days old) of larvae, and 33.5 Krad and 16 Krad for pupae. The emergence of adults can be prevented by 40 Krad of gamma irradiation applied to naked eggs, larvae, and pupae. All the emerged adults from each stage when irradiated with 20 Krad, lost their fertility. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 3313, 3351, 3374, 3452, 3668, 3671, 3686, 3687, 3699, 3704, 4044, 5418, and 5423.

3741 (AAEC/E-328) DOSE: A FORTRAN PROGRAM FOR THE CALCULATION OF RADIATION DOSE FROM RADIOPHARMACEUTICALS. Hetherington, E. L. R.; Wood, N. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

A FORTRAN program (DOSE) was written for the calculation of the radiation dose from internally deposited diagnostic radionuclides. It uses the basic dose equation of the Medical Internal Radiation Dose Committee and published absorbed fraction and decay data. Doses are calculated for a stated initial or cumulated activity in the whole-body and those organs in which significant uptake occurs. (auth)

3742 (LA-UR-74-1477) IMPORTANCE OF NONUNIFORM DOSE-DISTRIBUTION IN AN ORGAN. Richmond, C. R. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 50p. (CONF-740550-2). Dep. NTIS $5.50.

From second annual life sciences symposium on plutonium—health implications for man; Los Alamos, New Mexico, USA (22 May 1974).

The recent revival of interest in the hot particle problem, especially as regards particulate Pu and other actinide elements in the lung, stimulated this review. Nonuniformity of dose-distribution has been of concern to standards-setting bodies and other groups such as the National Academy of Sciences and to health protectionists for many years. Data are reviewed from animal experiments that are used by some to implicate particulate Pu as being especially hazardous to man. Other relevant biological data are also discussed. The basis of the ICRP recommendations for derived radiation protection standards is the average radiation dose to an organ and not the number of particles in the organ. This dosimetric basis for radiological protection has been in effect for many years and is based on observations on humans and experimental work with animals. Recently proposed risk estimates for plutonium-induced lung cancer of 5×10^{-4} per particle cannot be substantiated on the basis of our current knowledge. In fact, careful consideration of the experimental data shows that Pu is not more hazardous than the same amount of Pu distributed uniformly. Further, the data suggest that the potential hazard from Pu increases as the dispersion throughout the lung becomes more uniform. (auth)

3743 (RHL/WP-72.1) CYTOGENETIC STUDIES IN BRAZILIAN POPULATIONS EXPOSED TO NATURAL AND INDUSTRIAL RADIOACTIVE CONTAMINATION. Barcinski, M. A.; Aberu, M. C.; Fonseca, L. G.; Castro, L. E.; Costa Ribeiro, C. (Rio de Janeiro Univ. (Brazil). Instituto de Biofisica). 1972. Contract AT(11-1)-3489. 12p. (CONF-721240-1). Dep. NTIS $4.00.

From World Health Organization meeting of investigators on chromosome aberration analysis as a biological indicator of environmental effects; Mol, Belgium (4 Dec 1972).

Cytogenetic studies were performed in four populations exposed to natural or industrial radiation from the thorium and uranium series. Industrially exposed people consisted of the gas mantle workers producing kerosene lamps and the monazite processing ore millworkers. Studies of lymphocyte chromosomes revealed aberrations consisting of deletions, rings, and dicentrics. Tables are presented to show percentage of aberrations per total number of cells. Results showed an increase in chromosome aberrations induced by high natural radioactivity in persons living in the monazite sand area. (HLW)

3744 (SSI-1974-018) NATIONAL INSTITUTE FOR RADIATION PROTECTION RECOMMENDATIONS FOR RADIOACTIVE IDENTITY CARDS. (Statens Straalskyddsinstitut, Stockholm (Sweden)). May 1974. 68p. (In Swedish). Dep. NTIS (US Sales Only) $6.50.

The new Swedish identity cards are marked with promethium-147. Different aspects of the radiation hazards of handling and keeping the cards are described. The opinion of the National Institute of Radiation Protection on using radioactive isotopes in identity cards is that all unnecessary radiation should be avoided, although it is shown not to be dangerous and not exceeding the recommendations of ICRP. (Sweden)

3745 RADIATION PROTECTION. Eng. Times (Calcutta); 15: No. 370, 12(31 May 1973).

Activities connected with radiation protection in India are briefly reported. The Directorate of Radiation Protection (DRP) under its countrywide radiation hazards evaluation and control programme covered during 1972, 28,000 workers from 1775 institutions for radiation monitoring and conducted radiological protection survey in 314 institutions. Under the same programme, urine of persons handling open radiation sources is routinely monitored for assessing internal contamination. The DRP is also entrusted with giving advice in radiation safety, planning of radiation installations and radioisotope laboratories in various fields, giving permission for the possession and use of radiation sources and their transport, and evaluating the annual genetically significant dose to the population arising from radiological diagnostic procedures. (INIS)

3746 USE OF RADIOISOTOPES IN GYNECO-OBSTETRICS (EVALUATION OF 15 CASES). Preliminary Report. Trejo Rodriguez, G.; Serrano Palacio, E.; Abbud Abbud, E.; Lemus Rocha, A. Ginecol. Obstet. Mex.; 35: No. 29, 251-256(Mar 1974). (In Spanish).

Fifteen cases studied with the Nuclear Medicine Anatomopathology and Roentgendiagnosis departments are presented. The wide versatility of the diagnostic methods with radioisotopes makes it possible to evaluate the fetal and placental status, easily and safely. (auth)

3747 INVESTIGATIONS OF TRITIATED MANADIOL SODIUM DIPHOSPHATE (T-MNDP) AS A RADIOACTIVE DRUG. Mitchell, J. S. (Addenbrooke's Hospital, Cambridge, Eng.). Brit. J. Cancer; 29: No. 5, 373-388(May 1974).

Tritiated derivatives of Synkavit (menadiol sodium diphosphate, MNDP) of high specific activity were developed for potential use as radioactive drugs. The preliminary biological and physical studies, with emphasis on approximate radiation dosimetry and the necessary preliminary testing are summarized, followed by an account of the clinical investigations and trials carried out so far corresponding essentially to Phases I and II trials for a chemotherapeutic agent. In all, 214 patients with different sites and types of advanced and recurrent, inoperable, histologically verified malignant tumors including reticuloses were treated with doses of at least 1 Ci of the various preparations. Among the 203 evaluable treated cases, some form of response was observed in 23 out of 151 (15.2%) receiving the drug by intravenous injections and 13 out of 52 (25%) after intraarterial injections. For the sites and types of malignant diseases which showed responses after either intravenous or intra-arterial administration among the 55 patients surviving at least 3 months after the first injection, some form of response was observed in 32 but only 5 of these showed either a "complete" or a "partial" response. Further investigations, based on clinical trials with randomization for inoperable cases of carcinoma of the colon and pancreas are desirable. (auth)

3748 HOT PARTICLES. Dolphin, G. W. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 8, 8-9; 10(Jul 1974).

A paper entitled "Radiation Standards for Hot Particles: A Report on the Inadequacy of Existing Radiation Standards Related to Internal Exposure of Man to Insoluble Particles of Plutonium and Other Alpha-Emitting Hot Particles" by A. R. Tamplin and T. B. Cochran, U. S. Natural Resources Defence Council, 1974, is critically reviewed in the light of other evidence for the production of cancers in humans and animals locally irradiated to high doses. The risk of cancer developing in cells surrounding a hot particle is considered in terms of these results and it is concluded that the 1 in 2000 risk of cancer generation surrounding a hot particle estimated by Tamplin and Cochran cannot be substantiated. (UK)

Animals

Refer also to abstract 3730.

3749 (BNWL-SA-4929) LATE EFFECTS OF INHALED PLUTONIUM IN DOGS. Park, J. F. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. Contract AT(45-1)-1830. 46p. (CONF-740715-14). Dep. NTIS $5.50.

From fifth international radiation research congress meeting; Seattle, Washington, USA (14 Jul 1974).

Pulmonary neoplasia was the primary cause of death in beagle dogs 5 to 10 years after inhalation of $^{239}PuO_2$ depositing 0.2 to 2.0 μCi in the lungs (3 to 22 nCi/g lung). Approximately 10% of the alveolar deposited Pu was retained in the lungs 8 to 10 years postexposure with an estimated accumulated average radiation dose to the lungs of 2000 to 12,000 rads. Forty to fifty percent of the Pu was translocated to the tracheobronchial and mediastinal lymph nodes, 10 to 15% to the liver, 5% to the skeleton, and 5% to the abdomiral lymph nodes. The highest Pu concentration occurred in the lymph nodes followed in descending order by lungs, liver, and skeleton. Bone neoplasia was the primary cause of death in dogs 5 to 6 years after inhalation of $^{238}PuO_2$, depositing 2 to 5 μCi in the lungs (30 to 70 nCi/g lung). Thirty to fifty-five percent of the Pu was in the skeleton 5 to 6 years postexposure with an estimated accumulated average radiation dose to the skeleton of 100 to 300 rads. Five to thirty percent of the Pu was in the lungs, 15 to 30% in the liver, and 5 to 25% in the tracheobronchial and mediastinal lymph nodes. The highest Pu concentration occurred in the lymph nodes followed in descending order by liver, lung, and skeleton. After inhalation of $^{238}PuO_2$ or $^{239}PuO_2$ at these low levels, lymphopenia was the earliest observed effect, occurring 1 to 2 years after deposition of ≥ 80 nCi Pu in the lungs. (auth)

3750 MECHANISMS OF GENETIC RESISTANCE TO FRIEND VIRUS LEUKEMIA IN MICE. I. Role of ^{89}Sr-Sensitive Effector Cells Responsible for Rejection of Bone Marrow Allografts. Kumar, V.; Bennett, M.; Eckner, R. J. (Boston Univ.). J. Exp. Med.; 139: 1093-1109(May 1974).

Resistance to malignant erythropoiesis induced by Friend spleen focus-forming virus and resistance to marrow stem cell allografts are under genetic control. Strains of mice, e.g., C57BL/6 and B10.D2, which are homozygous for resistance at the Fv-2 locus, are also good rejectors of most bone marrow allografts. ^{89}Sr, a bone-seeking isotope, irradiates marrow but not other lymphoid organs and abrogates resistance to marrow allografts without suppressing T- or B-cell functions. Thus, marrow-dependent effector cells (M cells) seem to resist allogeneic stem cells. To test if the genetic resistance to Friend virus (FV) is also mediated by M cells, B6 mice were treated with ^{89}Sr using a dosage schedule known to abrogate resistance to allogeneic marrow cells. 9 days after FV infection of such mice, the spleens showed malignant erythroblastosis which could not be suppressed by prior hypertransfusion, a procedure which suppresses physiologic erythropoiesis. Such ^{89}Sr-treated B6 mice also supported extensive virus replication, while control mice did not. FV markedly suppressed the ability of ^{89}Sr-treated B6 mice to produce antisheep red blood cell (SRBC) antibodies, a feature seen normally only in genetically susceptible mice. Thus, ^{89}Sr-treated B6 mice behaved in these respects as if they were susceptible to FV. When increasing doses of ^{89}Sr were administered to B6 mice, a dose-related loss of resistance to FV was seen. Therefore, it appears that ^{89}Sr-sensitive M cells mediate the genetic resistance to FV. The results of experiments with ^{89}Sr indicated that genetically resistant mice would be expected to possess target cells which are susceptible to transformation by FV. To verify this corollary, bone marrow cells from B10.D2 ($Fv\text{-}2^{rr}$) mice were transplanted into previously infected and lethally irradiated DBA/2 ($Fv\text{-}2^{ss}$) recipients which share the same $H\text{-}2^d$ alleles. 5-15 days later, the spleens of DBA/2 primary recipients yielded transformed cells which were capable of producing splenic tumor colonies upon transplantation into adult, unirradiated B10.D2 secondary recipients. Thus, marrow transplantation from genetically resistant donors may provide a new mode of treatment for leukemia, by providing precursors of M cells and other immunocompetent cell types. (auth)

3751 TRANSPLANTATION AND TISSUE CULTURE STUDIES OF RADIATION-INDUCED OSTEOSARCOMA IN THE RAT. Geddes-Dwyer, V.; Bosanquet, J. S.; O'Grady, R. L.; Cameron, D. A. (Univ. of Sydney). Pathology; 6: No. 1, 71-78(Jan 1974).

Five bone-forming osteosarcomas induced in rats by ^{32}P were transplanted for periods of up to two years and were also established in vitro. Injections of cell suspensions from these tissue cultures resulted in the development of tumors with morphological features similar to those of the original tumor. Each of the tumors had a distinctive histological pattern that was maintained in transplants and in the tumors derived from explants. Serial transplantation and culturing in vitro caused no loss of specialized function as the cells retained their ability to synthesize and secrete a calcifiable matrix. With their maintenance of bone cell function and their constant distinctive histological pattern, these transplantable and explantable radiation-induced osteosarcomas appear to be a unique experimental model. (auth)

3752 EFFECT OF INCORPORATED ^{226}Ra ON COLONY FORMING UNITS OF BONE MARROW IN SPLENECTOMIZED MICE. Klener, V.; Svoboda, V. (Institut Hygieny a Epidemiologie, Prague). Acta Radiol., Ther., Phys., Biol.; 12: No. 2, 155-164(1973).

Hematologic data obtained in splenectomized mice for long periods after the intraperitoneal injection of ^{226}Ra (0.03 μCi/g) are reported. The colony forming units in the bone marrow were reduced throughout the whole experimental period. The peripheral blood counts were not changed significantly. (auth)

3753 INFLUENCE OF OESTROGENIC HORMONES ON CARCINOGENESIS AND TOXICITY OF RADIOSTRONTIUM. Nilsson, A.; Roennbaeck, C. (Foersvarets Forskningsanstalt, Stockholm). Acta Radiol., Ther., Phys., Biol.; 12: No. 3, 209-228(1973).

Groups of male and female CBA mice were treated with oestrogenic hormone alone, ^{90}Sr alone, or with oestrogen + ^{90}Sr. Among the males given both oestrogen and ^{90}Sr there was a mean number of 4.2 bone tumors/mouse with a mean induction time of 194.1 ± 2.6 days as compared with 2.3 among those given only ^{90}Sr. The mean induction time for the latter was 316.1 ± 1.1 days. The female mice treated with ^{90}Sr + oestrogen developed 4.1 bone tumors/mouse and those given ^{90}Sr alone 2.0. The induction times were 251.0 ± 4.1 and 379.3 ± 9.7 days, respectively. No bone tumors were found in the group of mice treated with only oestrogen. Osteoclastic and mixed osteosarcomas were frequent in combination treatment groups in contrast to the result when ^{90}Sr was given alone. (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 3388, 3389, and 3782.

3754 (BNWL-SA-5037) IN-VIVO DETECTION OF PLUTONIUM IN THE TRACHEOBRONCHIAL LYMPH NODES WITH A FIBER OPTIC COUPLED SCINTILLATOR. Swinth, K. L.; Park, J. F.; Voelz, G. L.; Ewins, J. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. Contract AT(45-1)-1830. 23p. (CONF-740930-4). Dep. NTIS $4.25.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

Experimental results showed that it is possible to count ^{239}Pu in the human tracheobronchial lymph nodes using a relatively safe and simple procedure. The new scintillation probes have greater sensitivity, less positional dependence and do not require placing high voltages within the body. The probe itself is completely passive. With a minimum detectable amount (MDA) of approximately 3.0 nCi, the probe can be used to perform counts on many occupationally exposed plutonium workers. With refinements the MDA could be reduced by a factor of two. The probe is not meant to replace whole-body counting techniques for Pu, but will allow one to determine the partitioning of dose from translocation materials and to continue counting plutonium when it disappears due to increasing attenuation of the x-rays as the material becomes more centrally located in the thorax (lymph nodes). The probe technique is not limited to plutonium counting. The intra-esophageal technique could be used for studying lymph node build-up of various materials tagged with low energy photon emitters. Similarly, the fiber optic coupling of a scintillator provides a biomedical probe which is passive and could be used for many studies. (auth)

3755 (LA-UR-74-1454) STUDIES OF PLUTONIUM IN HUMAN TRACHEOBRONCHIAL LYMPH NODES. McInroy, J. F.; Stewart, M. W.; Moss, W. D. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 21p. (CONF-740930-3). Dep. NTIS $4.25.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

Since 1959, tissues from 70 former employees of the Los Alamos Scientific Laboratory with occupational exposures to Pu were examined following autopsy. Chemical analyses of selected tissues were performed to determine the amount of Pu retained in the body at the time of death. Based on the measured tissue concentrations of Pu, extrapolations of total body burdens were made. Exposure in most cases was to inhaled Pu oxide aerosols. Thirty-three of the measured cases had Pu depositions in the tracheobronchial lymph nodes ranging from 0.1 to 4000 dis/min per gram of tissue (0.05 to 1800 pCi/g). The duration of exposures ranged from 4 to 30 years. Microscopic examination of representative sections of these lymph nodes revealed no abnormalities other than those which were directly attributable to the basic disease that caused the demise of the various persons in this study. The size distribution of Pu particles in nodes from one case was determined by exposure of tissue sections to nuclear track film. The estimated mass median diameter of the particles was 0.3 μm and the distribution had a geometric standard deviation of 1.6. It is estimated that 95% of the individual particles had corresponding Pu concentrations between 0.001 and 0.22 pCi. (auth)

3756 (WASH-1320) RADIOBIOLOGICAL ASSESSMENT OF THE SPATIAL DISTRIBUTION OF RADIATION DOSE FROM INHALED PLUTONIUM. Bair, W. J.; Richmond, C. R.; Wachholz, B. W. (USAEC, Washington, D. C.). Sep 1974. 45p. Dep. NTIS $4.00.

Experimental animal studies clearly indicate that inhaled radioactive particles move from the lung to other organs and may be excreted from the body by several mechanisms. The experimental data also show that truly uniform distributions of inhaled radionuclides in lung seldom, if ever, occur. However, because of the mobility of Pu within lung, there is some biological justification for averaging the radiation dose to the total tissue. Although particles deposited in lung are dynamic and mobile unless trapped, i.e., in scar tissue, experiments have simulated the static Pu particle to study the biological effects of truly hot spots of radioactivity in lung. These and other comparative experiments of uniform and nonuniform distributions of absorbed energy from radioactive particles suggest a biological sparing effect for both acute and late responses to the nonuniform distribution. Available experimental data indicate that averaging the absorbed radiation dose from Pu particles in lung is radiobiologically sound. After thirty years experience with Pu in laboratory and production facilities, there is no evidence that the mean dose lung model on which occupational radiation protection standards for Pu are based is grossly in error or leads to hazardous practices. Currently available data from occupationally exposed persons indicate that the nonhomogeneous dose distribution from inhaled Pu does not result in demonstrably greater risk than that assumed for a uniform dose distribution. Thus, empirical considerations lead to the conclusion that the nonuniform dose distribution of Pu particles in the lung is not more hazardous and may be less hazardous than if the Pu were uniformly distributed and that the mean dose lung model is a radiobiologically sound basis for establishment of Pu standards. (CH)

3757 ACTION OF HYPERTHERMIA ON THE RATE OF ^{131}I ELIMINATION FROM THE THYROID GLAND AND THE ORGANISM. Zaichik, V. E.; Pavlov, B. D.; Tkachev, A. V. (Research Inst. of Medical Radiology, Obninsk, USSR). Byull. Eksp. Biol. Med.; 78: No. 10, 51-55(Oct 1974). (In Russian).

In rats acted upon by hyperthermia, along with a depression of the iodine-concentrating mechanism in the thyroid gland, there occurred a mobilization of the intrathyroidal hormonal fractions, their intensive internal deiodation, active release of the non-hormonal iodine from the gland, and stimulation of ways of the extrathyroid iodine elimination. Hyperthermic action on man gives a qualitatively analogous effect. A brief hyperthermic action after the accumulation of radioiodine by the thyroid gland considerably decreases the absorbed dose for the thyroid gland and the organism and can be regarded as a prospective agent in the complex therapy of radioiodine intoxication. (auth)

3758 THE KINETICS OF RADIO-STRONTIUM. Firusian, N. (Essen Univ. (Gesamthochschule) (F. R. Germany). Innere Klinik und Poliklinik–Tumorforschung). Nucl.-Med.; 13: No. 2, 127-138(Aug 1974). (In German).

4 figs.; 4 tabs.; 17 refs.

The kinetics of ^{85}Sr was examined using pathological and physiological cases. The results are reported. Generalized malignant skeletal diseases showed a reduced elimination and an increased retention of the nuclide. Circumscribed malignant skeletal lesions failed to show any considerable abnormality in the final studies. In comparison to the normal skeletal regions, these circumscribed lesions showed a considerable prolongation of the radionuclide. (auth)

Animals

Refer also to abstracts 3387, 3478, and 3749.

3759 (CEA-CONF-2675) SYNTHESIS AND DISTRIBUTION KINETICS OF ^{11}C CHLORPROMAZINE IN ANIMALS. Maziere, M.; Sainte-Laudy, J. L.; Crouzel, M.; Comar, D. (CEA, 91 - Orsay (France). Service Hospitalier Frederic Joliot). [nd]. 12p. (CONF-740203-8). Dep. NTIS (US Sales Only) $4.00.

From international symposium on radiopharmaceuticals; Atlanta, Georgia, USA (12 Feb 1974).

Carrier-free ^{11}C-chlorpromazine was synthesized in 25 minutes by the methylation of Nor-1 chlorpromazine by carrier-free ^{11}C formaldehyde. The radioactivity of the product ready for injection is about 4 mCi. ^{11}C-chlorpromazine is obtained without carrier but it was not possible to separate the labelled molecule from its demethylated stable precursor, present in fairly small quantities ($<300\ \mu g$). This method of synthesis offers a wide field of application since it can be used for the ^{11}C labelling of any molecule possessing a primary or secondary amino group, molecules much used in chemical therapy and belonging to various families of drugs: hypnotics, antiepileptics, psychodepressors, antipyretics, local anaesthetics, ganglioplegics, antihistaminics, hormones, antibiotics and antimitotics. A study on animals of the fast distribution kinetics of ^{11}C chlorpromazine hydrochloride administered intravenously shows, in both rabbits and monkeys, a very early radioactivity buildup in the brain and lungs (immediately after injection). The lung and brain activities develop and decrease during the experimental period (about 60 minutes) whereas that of the liver increases. Quantitative results obtained on mice in vitro, after removal of the organs and counting of the activity obtained by intravenous injection of ^{11}C-chlorpromazine hydrochloride prove that the radioactivity observed is indeed an accumulation and is not due to passage of the blood flow, the blood activity remaining low throughout. No tumour fixation of ^{11}C-chlorpromazine was observed in the mice under our experimental conditions. A quantitative kinetics study of ^{11}C-chlorpromazine in vivo is not easy to pursue in animals such as rabbits or monkeys, and even less so in mice, in view of the size of the animal and the resolution of the gamma camera collimator. But the aim of this work is the application to humans of this new pharmacokinetics method. (auth)

3760 (COO-3167-100) ALKALINE EARTH TRANSPORT AND THE CALCIUM-BINDING PROTEIN. Progress Report, July 1, 1973–June 1, 1974. Wasserman, R. H. (Cornell Univ., Ithaca, N. Y. (USA)). 1974. Contract AT(11-1)-3167. 21p. Dep. NTIS $4.25.

Progress is reported from studies on various aspects of the transport of alkaline earth metals and phosphate across the gastrointestinal tract membranes, with emphasis on the role of vitamin-D in phosphate transport. A factor in the South American plant, Solanum malacoxylon, was uncovered which has properties analogous to the active form of vitamin D, 1,25-dihydroxy-cholecalciferol, and some of its chemical properties were determined. The investigation of the transport of phosphate across the intestine of chicks in vitro and in vivo was continued, and it was found that ^{32}P transport has a vitamin D-dependent component, is dependent on Na^+, possibly involves the Na, K stimulated -Mg dependent ATPase, and is not inhibited by L-phenylalanine, a specific inhibitor of intestinal alkaline phosphatase. Alteration of the diet showed that a calcium-deficiency or phosphorus-deficiency has relatively little effect on ^{32}P absorption in vivo but greatly enhances ^{47}Ca absorption and CaBP synthesis. High strontium diets inhibited ^{47}Ca absorption and CaBP synthesis but also had little effect on ^{32}P absorption. Investigations with the embryonic chick intestine in organ culture revealed a possible involvement of the adenylate cyclase system and cyclic AMP in its response to vitamin D and vitamin D metabolites. (CH)

3761 (LF-tr-92) EVALUATION OF MICRODISTRIBUTION OF α-EMITTING ISOTOPES IN LUNG TISSUE. Pavolvskaya, N. A.; Potapova, I. N.; Pavlovskii, F. A. Translated from Med. Radiol.; 18: 30-34(1973). 10p. Dep. NTIS $4.00.

Methods used for determining the microdistribution of α-emitting radioisotopes in the lungs of mammals are reviewed. Data from the literature indicate that α-emitting isotopes have an extremely uneven distribution in the respiratory tract. The most complete information can be obtained from autoradiograms of tissue samples in which the location of each radioactive particle can be determined from the tracks of alpha particles emitted by it. (CH)

3762 INCORPORATION OF ^{32}P ORTHOPHOSPHATE INTO ENERGY-RICH COMPOUNDS OF MUSCLES OF SCHISTOCERCA GREGARIA DURING REST AND FLIGHT. Strunecka, A.; Kubista, V. (Charles Univ., Prague). Physiol. Bohemoslov.; 23: No. 5, 395-405(1974).

The in vivo incorporation of ^{32}P into haemolymph orthophosphate and red and white muscle orthophosphate, phosphoarginine, and of the γ- and β-phosphate of ATP was followed in Schistocerca gregaria after a single injection of ^{32}P–orthophosphate. Equilibration of radioactivity between haemolymph and muscle orthophosphate lasts 24 hours in red and considerably longer in white muscle. This is ascribed to the low permeability of insect muscle to orthophosphate. Equilibration between muscle orthophosphate and γ-phosphate of ATP was found to take place much more rapidly in red than in white muscle. Equilibration between γ- and β-phosphate of ATP is also slower in white muscle. In red muscle, phosphoarginine is not in equilibrium with the γ-phosphate of ATP half an hour after injection of ^{32}P. A flight of 15 min duration [begun 15 min after ^{32}P administration] considerably speeds up the equilibration between the γ-phosphate of ATP and phosphoarginine and γ- and β-phosphates of ATP. In white muscle, equilibration between γ- and β-phosphate was found to be accelerated while the exchange between γ-phosphate of ATP and phosphoarginine was strongly suppressed. (auth)

3763 INCREASED TOXICITY OF Na_3CaDTP WHEN GIVEN BY PROTRACTED ADMINISTRATION. Taylor, G. N.; Williams, J. L.; Roberts, W. L.; Atherton, D. R.; Shabestari, L. (Univ. of Utah, Salt Lake City). Health Phys.; 27: No. 3, 285-288(Sep 1974).

Protracted administration greatly enhanced the toxicity of Na_3CaDTP in beagles. Injections of 5.8 μmoles/kg of Na_3CaDTP, given every 5 hr, were fatal as early as 4 days after the onset of treatment. The most serious lesions were induced in the epithelial lining and related structures of the intestinal tract. Protracted administration of equal molar amounts of Na_3ZnDTP was found to be much less toxic. (auth)

3764 ABSORPTION, DISTRIBUTION, AND MILK SECRETION OF RADIONUCLIDES BY THE DAIRY COW. III. Radiotellurium. Mullen, A. A.; Stanley, R. E. (National Environmental Research Center, Las Vegas, NV). Health Phys.; 27: No. 3, 279-284(Sep 1974).

Four lactating cows were confined in metabolism stalls and each given a single oral dose of ^{129m}Te. For the next 5 days, all milk, urine and feces from the cows were collected and the ^{129m}Te content measured. The highest concentration of ^{129m}Te in the milk was 0.0035%/1.18 hr following administration of the nuclide. The activity decreased with a biological half-time in the milk of 38 hr. The total activity transferred to milk was limited with 0.254% of the administered nuclide secreted in approximately 13 days. Thirty hours after dosing, 49% of the administered activity had been excreted by all routes. After 5 days 80% of the activity had been recovered with 95% of this activity recovered in the feces. In a companion study three calves were administered radiotellurium orally and sacrificed after varying time periods to determine tissue distribution. The radiotellurium was found to be distributed throughout the body of calves with the main concentration occurring in the kidney and liver. (auth)

3765 EXPERIMENTAL BACKGROUND FOR PROMPT TREATMENT WITH DTPA OF ^{239}Pu-CONTAMINATED WOUNDS. Volf, V. (Kernforschungszentrum, Karlsruhe, Ger.). Health Phys.; 27: No. 3, 273-277(Sep 1974).

Rats were injected intramuscularly with ^{239}Pu in the form of nitrate, citrate or DTPA chelate. Differences were observed in the distribution pattern of ^{239}Pu and in the response to DTPA treatment, depending on the ^{239}Pu-compound injected. In general, a 3-hr intravenous infusion of $Na_3CaDTPA$ (30 to 120 μmoles · kg^{-1}) was more effective than the rapid intravenous injection. Furthermore, the effect of DTPA was dose-dependent only as far as ^{239}Pu-citrate was concerned. Best effects were, however, achieved by injecting DTPA intramuscularly into the vicinity of the ^{239}Pu-deposit. Enhanced absorption of the chelated ^{239}Pu did not result in its increased uptake by the body organs. The practical implications of these findings are discussed. (auth)

3766 BEHAVIOR OF INTRAVENOUSLY INJECTED $^{51}CrCl_3$ IN IRRADIATED AND NONIRRADIATED MICE. Frankendal, B.; Stigbrand, T. (Umeaa Univ., Sweden). Acta Radiol., Ther., Phys., Biol.; 12: No. 4, 327-336(1973).

The distribution of intravenously injected $^{51}CrCl_3$ was investigated in whole blood, plasma proteins, and the low molecular part of the blood in irradiated and nonirradiated mice. The chromium atoms are selectively bound to the plasma protein transferrin. A relative increase in the chromium label occurs during the first 24 hours and 48 hours after the injection the distribution remains unchanged. (auth)

Plants

Refer also to abstract 5482.

3767 (BNWL-SA-5132) SUSPENDED PARTICLE INTERACTIONS AND UPTAKE IN TERRESTRIAL PLANTS. Vaughan, B. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 21 Aug 1974. Contract AT(45-1)-1830. 22p. (CONF-740921-17). Dep. NTIS $4.25.

From atmosphere – surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

Ten-day old bean plants, Phaseolus vulgaris, were used for studies on foliar uptake rates. Results are reported for the following experiments: deposition of ^{198}Au-labeled aerosol; inhibitory effects of high mass loading on leaves exposed to glycerol aerosols; translocation of ^{22}Na from leaf to root; metabolic transport of ^{22}Na-labeled glycerol aerosol particles in stems and roots; effects of leaching on radioactivity in the leaf; and effects of vector type and particle size on radioactivity transport. (HLW)

3768 KINETIC STUDIES ON NITROGEN INDUCED UPTAKE OF ^{32}P BY EXCISED ROOT SYSTEMS OF MAIZE. Subramaniaiyer, P. R. V.; Saxena, M. C.; Sharma, D. (Pant Univ. of Agricultural Tech., Pantnagar, India). Indian Soc. Nucl. Tech. Agr. Biol., Newslett.; 2: No. 1, 39-41(1973).

Excised roots of 5 day old Ganga-5 hybrid maize were used for studying the ^{32}P uptake. The time course study revealed that a large portion of phosphate accumulated through active process, if the duration of the study exceeded 60 min. The kinetic curves plotted using the data for 180 min. verified the nature of uptake reported by earlier workers. The inducing effect of directly given NO_3–N was also apparent at all levels of N (viz., 5 and 10 mM) and at all concentrations of P (viz., 0.05 to 100 mM). The values of kinetic constants indicated that the controlling step for N induced uptake of P at the concentration ranges of P used in this experiment could be the step at which the dissociation of carrier-P complex occurs. This verified the hypothesis put forward earlier to explain the inducement phenomenon. The results of the present experiment also showed that excised roots behaved similarly to intact plants in this respect. (Indian Sci. Abstr.)

3769 COMPARATIVE UPTAKE OF GAMMA-EMITTING FISSION PRODUCT NUCLIDES BY PLANTS. D'Souza, T. J.; Mistry, K. B. (BARC, Bombay). Indian Soc. Nucl. Tech. Agr. Biol., Newslett.; 2: No. 1, 17-20(1973).

The comparative uptake of long-lived gamma-emitting fission product nuclides ^{106}Ru, ^{125}Sb, ^{137}Cs and ^{144}Ce, present in global fallout from nuclear explosions, by maize plants was examined in water culture experiment. Over identical duration of plant growth, the extent of accumulation of the radionuclides in aerial tissues was in the following decreasing order: ^{137}Cs>, ^{125}Sb>, ^{106}Ru> and ^{144}Ce. In roots, however, the retention of ^{144}Ce and ^{106}Ru was greater than that of ^{137}Cs and ^{125}Sb. Complementary studies with maize and rice grown in two contrasting soil types, namely, laterite and black clay loam, indicated that ^{137}Cs uptake by plants was markedly greater than that of ^{144}Ce in the black soil. In the laterite, however, ^{144}Ce uptake far exceeded that of ^{106}Ru and ^{125}Sb. In general, maize removed higher amounts of the radionuclides than rice from both the soils. (Indian Sci. Abstr.)

New Tracer Techniques

Refer also to abstracts 3461 and 3741.

3770 (AED-CONF-74-018-002) NEW POSSIBILITIES IN THE DIAGNOSIS OF ADRENAL CORTEX USING RADIOACTIVELY LABELLED CHOLESTEROL. Montz, R. (Hamburg Univ. (F. R. Germany). Radiologische Klinik und Strahleninstitut). 1974. 6p. (In German). INIS.

Improvements in the use of ^{131}I-cholesterol for adrenal scintigraphy are reported. Injection of 0.7 μCi of the substance into the patient resulted in a whole-body dose of 0.7 rad, a gonad dose between 1 and 3 rad, and adrenal gland dose of about 30 rad. A gamma camera was used for taking pictures with subsequent computer processing of the data. A modification of the technique was to perform scintigraphy of each adrenal gland separately thus avoiding superposition of data due to concentration of ^{131}I-cholesterol in the liver. Preliminary results on patients with adrenal diseases such as hirsutism, Cushing's syndrome, or after adrenalectomy, are described. The effect of dexamethasone on the adrenal tissue, the enhanced uptake of cholesterol in patients with Cushing's syndrome, and the unilateral uptake in adrenal adenomas can be detected by this method which is therefore a useful tool in identification of adrenal diseases. (INIS)

3771 (BNWL-SA-5120) MODELLING MINERAL CYCLING BY PERIPHYTON IN A SIMULATED STREAM SYSTEM. Cushing, C. E.; Thomas, J. M.; Eberhardt, L. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. Contract AT(45-1)-1830. 10p. (CONF-740826-4). Dep. NTIS $4.00.

From International Association of Limnology meeting; Winnipeg, Canada (22 Aug 1974).

A simulation model of periphyton dynamics was developed for studies on mineral cycling. Equations were developed for estimation of uptake and retention rates. Questions concerning absorptive and adsorptive mechanisms are being investigated. Experiments were begun using the microcosm and ^{137}Cs as a tracer for studying potassium kinetics. Zinc-65 and ^{137}Cs were used for studies on saturation kinetics and adsorption using inert substrates. (HLW)

3772 RADIOMETRIC AND HISTO-AUTORADIOGRAPHIC STUDY OF THE THYROID FUNCTION IN NUTRIA. Yunusov, A.; Akhmetov, I. Z.; Shaikhov, R. T. (Inst. of Zoology and Parasitology, Tashkent). Uzb. Biol. Zh.; No. 2, 30-32(1974). (In Russian).

The absorption and localization of ^{131}I in the microstructures of the thyroid gland in nutria at different seasons of the year was studied by radiometric and autoradiographic methods. In each season, 8 to 10 individual nutria were studied. The functional activity of the thyroid gland undergoes seasonal changes. The highest concentration of radioactive iodine in the gland was noted in the spring. (tr-auth)

3773 NUCLEAR IRRADIATION AND RADIOISOTOPE APPLICATIONS IN INVESTIGATIONS ON PLANT PHYSIOLOGY. Vlasyuk, P. A. pp 114-123 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. II. Moscow; Atomizdat (1971). (In Russian).

Studies were made on the use of radioactive indicators and ionizing radiation in different branches of modern physiology and biochemistry of plants. A number of new factors were observed and principles of feeding of and metabolism in plants were clarified, which are at the basis of development of methods for increasing agricultural productivity. With radioactive indicators it was possible to follow the path of biosynthesis of many organic compounds in plants. Study of the action of ionizing radiation on plants and seeds is related to solution of two problems: the effect of small radiation doses on plants and the mechanisms of protection of plants on somatic damage in radiation mutagenesis. The reaction of plants depends on the primary physical processes that occur in plant cells on irradiation of molecules and on the conditions and nature of the development of secondary processes that take place after the irradiation. (tr-INIS)

3774 GAMMA-ORBITOGRAPHY WITH ^{203}Hg–NEOHYDRIN AND ^{67}Ga-CITRATE. Lommatzsch, P.; Altenbrunn, H. J. (Robert-Roessle-Klinik, Berlin). Ophthalmologica; 168: 392-399(1974). (In German).

The existing literature concerning results of γ-orbitography was surveyed. Thirteen cases of unilateral exophthalmus were examined by this method using ^{203}Hg-neohydrine. In 9 cases γ-activity was raised in the suspected orbits (metastases, retothelsarcoma, meningioma, adenocarcinoma, histiocytoma, pseudotumor), but in 4 cases there was no increase in γ-activity (haemangioma, melanoma, retothelsarcoma, unexplained exophthalmus). In 2 patients (metastases of breast cancer and sphenoid wing meningioma) the use of ^{67}Ga-citrate gave more marked raise of γ-activity than the use of ^{203}Hg-neohydrine. (auth)

3775 ISOTOPE METHOD OF CIRCULATING BLOOD VOLUME DETERMINATION IN LIVING BEINGS AND THE APPARATUS FOR SUCH DETERMINATION. Grabarczyk, R. (Zjednoczone Zaklady Urzadzen Jadrowych Polon, Bydogszcz). Probl. Tech. Med.; 4: 241-245(1973). (In Polish).

Certain physical problems, concerning the isotope method of circulating blood determination in living organisms, are brought up. Construction of a calculating apparatus utilized in this technique is described and its technical parameters are given. (Nucl. Sci. Abstr. Pol.)

3776 SIMPLER RADIOISOTOPE METHOD FOR THE DETERMINATION OF FAECAL FAT. Barnard, D. J. (County Hospital, York, Eng.). Med. Lab. Technol.; 30: 239-244(Jul 1973).

A simple radio-isotope single sample counting technique is described for the determination of faecal fat excretion using ^{125}I-labelled triolein with ^{46}Sc–scandium chloride as an unabsorbable marker. The method showed agreement with both chemical fat analysis and routine isotope total collection procedure. The single sample counting technique is considered to be more accurate and saved considerable technician and equipment usage time. (auth)

3777 ^{85}Sr UPTAKE STUDY IN NON-UNION IN MAN. Segmueller, G.; Bekier, A.; Cech, O. (University Clinic, Prague). Eur. Surg. Res.; 2: 226-232(1970).

A modified technique of external counting of the isotope ^{85}Sr was used on patients suffering from non-union of the tibia. The relative value of increased radioactivity at the site of the pseudarthrotic lesion is expressed by the activity ratio. Recordings at 6 to 7 equally spaced locations of both tibiae were obtained during 1 week after injection of the tracer. Tracer uptake is increased in the diseased tibia immediately after injection. Radioactivity remains high at the site of the lesion, while in normal bone it decreases rapidly. The activity ratio, therefore, is rising steadily. The method seems valuable in evaluating the dynamic state of bone repair. "Atrophic non-union" as a clinical entity may not reflect the actual osteogenic potential of the lesion. (auth)

3778 RELATION BETWEEN CONCENTRATION OF ^{197}HgCl$_2$ AND THERAPEUTIC EFFECTS OR SURVIVAL TIME IN LUNG CANCERS. Usui, N. (Shinshu Univ., Nagano, Japan). Shinshu Igaku Zasshi; 21: No. 5-6, 515-524(Dec 1973). (In Japanese).

The relationship between concentration of ^{197}HgCl$_2$ and therapeutic effects or survival time was studied in 35 cases with primary lung cancer who had received lung scintigraphy with ^{197}HgCl$_2$. The concentration of ^{197}HgCl$_2$ had a tendency to be remarkable with disease phase. The concentration was low in lung cancer of less than 3 cm in diameter. In the tumors of 3 to 6 cm in diameter the concentration ranged from low to high. As for the relationship between the histological types of the lung cancer and concentration of ^{197}HgCl$_2$, the concentration was higher in the epidermoid cancer. There were many cases with low concentration as in the cases with adenocarcinoma. The therapeutic effect by x rays was superior in the cases with high concentration of ^{197}HgCl$_2$. However, there was not always a relationship between high concentration of ^{197}HgCl$_2$ and survival time. In the relationship between survival time by positive chemotherapy and concentration of ^{197}HgCl$_2$, survival time tended to be longer when the concentration was low in III and IV phases. The same relationship was obtained in the cases with adenocarcinoma. (JA)

3779 SPECIFICITY AND SENSITIVITY OF RADIOIMMUNOASSAY FOR HEPATITIS B ANTIGEN. Irwin, G. R.; Allen, A. M.; Bancroft, W. H.; Willhight, M.; Russell, P. K. (Walter Reed Army Inst. of Research, Washington, DC). Appl. Microbiol.; 28: No. 4, 600-604(Oct 1974).

Sera from a survey of 6,026 people were tested for hepatitis B surface antigen by using radioimmunoassay and counterelectrophoresis. Forty-eight sera (0.79%) were positive by counterelectrophoresis and 152 sera (2.52%) were positive by radioimmunoassay, using the most liberal of the recommended criteria for positivity (i.e., counts 3 standard deviations above the mean). Absorption tests performed on the 152 radioimmunoassay-positive sera showed that 10 (6.6%) were false-positive reactions to guinea pig protein, 74 (48.6%) were due to false-positive reaction(s) with other protein(s) in the test system, and 68 (44.8%) were true positives. There was a strong correlation between the degree of elevation of radioactive counts and the proportions of sera that were true positives; all 49 sera with counts > 50 standard deviation units above the mean were true positives, but only 19 (18.4%) of the 103 sera with counts < 50 standard deviation units were true positives. A few sera with high counts required absorption with type-specific (type D) antisera. The following conclusions were reached from this study: (i) absorption tests should be run on all radioimmunoassay-positive, counterelectrophoresis-negative sera; (ii) most (about 90%) false positives are not due to anti-guinea-pig protein reactions; and (iii) radioimmunoassay, in combination with absorption tests, yields a modest increase (about 35%) in detection of true positives over use of counterelectrophoresis alone. (auth)

3780 DETECTION OF DECONJUGATION OF BILE SALTS BY MEASUREMENT OF THE SPECIFIC ACTIVITY OF ^{14}CO$_2$ IN EXPIRED AIR. Myerson, R. M.; Pineda, V. L.; Levison, M. E.; Rabinowitz, J. L. (Veterans Administration Hospital, Philadelphia). Amer. J. Med. Sci.; 267: No. 1, 35-39(Jan 1974).

Procedures currently available to detect bile acid deconjugation are technically difficult and are not routinely performed in clinical practice. We have assessed bile acid deconjugation by measuring ^{14}CO$_2$ specific activity of breath samples taken at intervals following the oral administration of 1-^{14}C glycocholic acid and of 1-^{14}C taurocholic acid. The test is based on the fact that during deconjugation, the amino acid and cholic acid moieties are split and the labeled carbon is converted to ^{14}CO$_2$ and exhaled. Controls and a number of patients with various malabsorption syndromes have been studied. Included were patients with bacterial overgrowth syndromes, ileal bypass, gastrocolic fistula, regional ileitis, cirrhosis of the liver, and chronic pancreatitis. The results indicate that breath analysis provides a simple, inexpensive and reliable screening technique for the detection of bile acid deconjugation. (auth)

3781 PHYSIOLOGICAL METHOD FOR LABELLING PLASMA LIPOPROTEINS WITH RADIOACTIVE CHOLESTEROL. Sodhi, H. S.; Kudchodkar, B. J. (Univ. of Saskatchewan, Saskatoon). Clin. Chim. Acta; 51: 291-301(26 Mar 1974).

To study the metabolism of plasma cholesterol, it is necessary to have the tracer in the same physical state as the plasma cholesterol itself. A number of in vitro methods have therefore been designed to incorporate radioactive cholesterol into plasma, but most of them have not proven satisfactory, except perhaps one which appears promising in this regard. The plasma in this method is labelled by transfer of radioactive cholesterol from red blood cells through a process of exchange, so that on theoretical grounds all the radioactive cholesterol should be present in plasma lipoproteins; and this was supported by the experimental data. On agarose electrophoresis of the labelled samples, the radioactive cholesterol added through exchange with red blood cells was present only in association with lipoproteins; whereas, significant fractions of the tracer incorporated by other methods in current use were not present with the lipoproteins. The rate of disappearance from circulation of radioactive cholesterol incorporated into plasma by the former method was similar to that of cholesterol native to lipoproteins, but the rates of disappearance of radioactive cholesterol incorporated into plasma by other methods were much faster than normal. Preliminary work has also suggested that the red blood cell exchange method can be successfully employed to study the metabolism of free cholesterol in isolated lipoproteins. (auth)

3782 USE OF RADIOISOTOPES IN DERMATOLOGIC DIAGNOSIS. Kubickova, V.; Kubicek, M. (Bezirkskrakenhauses, Cologne). Berufsdermatosen; 22: 23-28(Feb 1974). (In German).

The resorption of radioactive isotopes, and especially of Na$_2$^{51}CrO$_4$ or of labelled components of the skin, was studied in healthy persons and in eczematics who were both sensitized or not, to chromium. The resorption is measured by determining the decrease of the radioactivity. In persons who are sensitized to chromium, the resorption from the skin is accelerated, while it is slowed down in animals exposed several times to chromium. The investigation of the decrease of the activity of radioactive isotopes in the skin is a convenient and reliable method in dermatology. In animals, the sensitivity notion ought to be defined. (auth)

3783 SCINTIGRAPHY OF AUTONOMIC NODULES OF THYROID GLAND COMPARED WITH THEIR MORPHOLOGY. Gasiorowski, W.; Gabryelewicz, M. B.; Misztela, G.; Gawdzinski, M.; Olender, A. Endokrynol. Pol.; 25: No. 5, 415-425(1974). (In Polish).

The scintigrams of toxic and nontoxic autonomous thyroid nodules in close relation to the pathological picture are presented. There was found that autonomous nodules are nonuniform pathologically as well as in radioiodine accumulation. In case of not uniform radioiodine accumulation in nodule it can be explained by its morphological structure. The authors emphasize a value of pathological examination in the accurate interpretation of thyroid scintigrams. (auth)

3784 STIMULATION OF THYROID IODINE UPTAKE WITH TSH. Gorowski, T.; Bednarski, A. Endokrynol. Pol.; 25: No. 5, 427-435(1974). (In Polish).

In 82 cases of various thyroid diseases the stimulation of thyroid iodine uptake with TSH was performed. The results of investigation are as follows: the indication for performing the test are in the first cases of hot thyroid nodules, besides. The necessity of thyroid reserve estimation and stimulation of thyroid iodine uptake depressed by previous iodine or thyroid preparations in talc. The dose of TSH (Ambinon-Organon) should be 100 Heyl-Laqueura for 3 days. In young individuals and with ill-toleration of the drug there may be a lowering of the dose to the 100 Heyl-Laqueura units for 2 days. In cases of hot nodules of thyroid the result should be estimated by scintigraphy; the percentage of iodine uptake is inconclusive. The administration of TSH usually stimulates radioisotope accumulation in previously afunctional thyroid tissue. Sometimes one can see a paradoxical drop of iodine uptake by hot nodules. The TSH administration can be badly tolerated. The pretreatment with B-blocking agents lowers the risk of after-TSH thyreotoxicosis. (auth)

3785 RELIABILITY OF RADIOISOTOPE DIAGNOSIS OF HEART LEFT-RIGHT SHUNT AND COMPARISON BETWEEN VARIOUS HAEMODYNAMIC PARAMETERS. Tarolo, G.; Cantalupi, D.; Carrer, M.; Rossi, A. (CURAMIN, Varese, Italy). Radiol. Med.; 60: No. 7, 581-590(Jul 1974). (In Italian).

The reliability of radioisotopic diagnosis in cases of left-right shunt and the sensitivity of individual parameters determined by means of this method are discussed in statistical terms with reference to a series of 45 cases. The results appeared satisfactory. (auth)

3786 APPLICATION OF A COMPUTER IN ASSOCIATION WITH THE GAMMA CAMERA. Galli, G.; Salvo, D.; Troncone, L.; Regi, M.; Piraccini, R. (Catholic Univ., Rome). Radiol. Med.; 60: No. 7, 591-603(Jul 1974). (In Italian).

An on-line link with a computer offers total automation of some gamma camera examinations, from the acquisition of data to the printing out of the finding. Off-line connection can be employed for a number of useful purposes, such as the processing of data obtained with a variety of instruments, the presentation of experimental results in graphic form, and the presentation of scintiscan findings. Examples of these various forms of use are illustrated. (auth)

3787 EFFECT OF HYPERTONIC SALINE ON THE UPTAKE OF TRITIATED 7,12-DIMETHYLBENZ(A)ANTHRACENE BY THE GASTRIC MUCOSA. Capoferro, R.; Torgersen, O. (Rikshospitalet, Oslo). Scand. J. Gastroenterol.; 9: No. 4, 343-349(1974).

The stomachs of pylorus-ligated rats and guinea-pigs were rinsed with 0.15 M or 2 M saline before and two hours after intragastric instillation of tritiated 7,12-dimethylbenz(a)anthracene (DMBA). The uptake of radioactivity by the gastric wall was measured by liquid scintillation counting. In rats, the radioactivity of the forestomach was more than ten times higher than that of the glandular stomach. In both rats and guinea-pigs the radioactivity tended to decrease from the fundus to the antrum. Rinsing the stomach with 2 M saline two hours after instillation of ^{3}H-DMBA reduced the PAS-stained mucus as well as the radioactivity of the gastric wall. This may indicate that gastric mucus binds DMBA and that hypertonic saline washes the mucus away. Rinsing the stomach with 2 M saline before instillation of ^{3}H-DMBA caused an increased uptake. This observation may be of significance with regard to the pathogenesis of stomach cancer, since earlier epidemiologic studies have pointed to a high consumption of salted food in populations with high incidence of this disease. (auth)

3788 RADIOACTIVE TAGGING FOR ESTIMATING LEAF FEEDING INSECT DAMAGE TO JUTE PLANTS. Shahjahan, M.; Miah, M. A. H. (Atomic Energy Centre, Dacca, Bangladesh). Int. J. Appl. Radiat. Isotop.; 25: No. 8, 378-379(Aug 1974).

To evaluate the effectiveness of various mutants of jute against defoliation by caterpillars, the mutants were cultivated in a controlled environment and fed with ^{32}P in the form of P_2O_5 (0.4 mCi/g P_2O_5). Leaves from each mutant were bottled with jute hairy caterpillars. After 16 hr feeding the caterpillars and their excreta were removed, pasted together and radioassayed. Since susceptible mutants would be eaten more by the caterpillars than the resistant ones, lowest count rates were obtained from the most resistant mutants. (UK)

3789 RADIOIMMUNOASSAY ON POLYCARBONATE MEMBRANES: A SENSITIVE AND SIMPLIFIED METHOD FOR THE DETECTION AND QUANTITATION OF ANTIBODY. Green, R. L.; Scales, R. W.; Kraus, S. J. (Dept. of Health, Education, and Welfare, Atlanta). Appl. Microbiol.; 27: No. 3, 475-479 (Mar 1974).

A new radioimmunoassay technique is described in which a sampling manifold and polycarbonate filter membranes are used. Antigen-antibody reactions take place on the membranes. The manifold permits the simultaneous running of 30 samples and a rapid wash technique in which the washing solution is introduced into the manifold wells and suctioned off from below. The polycarbonate membrane offers a distinct advantage over the cellulose acetate in that nonspecific protein adsorption is substantially reduced. Antigens employed are whole bacteria or soluble antigen coupled to Sepharose beads and are layered over the membrane surface. A radiolabeled antibody is used to measure the primary antigen-antibody interaction. The sensitivity of the procedure is equal to that of fluorescent antibody tests. (auth)

3790 RADIOMETRIC DETECTION OF BACTEREMIA IN NEONATES. Bannatyne, R. M.; Harnett, N. (Hospital for Sick Children, Toronto). Appl. Microbiol.; 27: No. 6, 1067-1069 (Jun 1974).

The predicted prevalence of false positive blood cultures due to hyperactive neonatal blood cells in a radiometric detection system was confirmed. Suppression of this blood background radioactivity in the system was achieved by using a hypertonic medium containing 10% sucrose. The radiometric system produced accurate results as fast as the conventional blood culturing method, saved labor, and minimized the recovery of extraneous contaminants. (auth)

3791 INTERACTIONS OF STANDARD ANTIBODY WITH AUSTRALIA ANTIGENS IN Au Ag—Ab RADIOIMMUNOASSAY. Daugharty, R. G.; Young, R. G.; Hatch, M. H.; Ziegler, D. W. (Dept. of Health, Education, and Welfare, Atlanta). Appl. Microbiol.; 27: No. 4, 756-762(Apr 1974).

Human antisera against Australia (Au) antigen have been characterized by liquid-phase radioimmunoassay (RIA) for their precipitation of ^{125}I-labeled Au antigen. The end-point dilutions of sera (anti-Au) which precipitated 50% of ^{125}I-Au antigen by RIA correlated well with complement fixation titers but had a much wider range, indicating a greater precision and perhaps a better sensitivity of assay. Anti-Au serum diluted to precipitate 50% of ^{125}I-labeled Au antigen was used as standard antibody in RIA tests to detect either inhibition or enhancement of the reaction by preincubated mixtures of Au antigen and antibody specimens. Without free Au antigen or antibody in the resultant mixtures there was no inhibition or enhancement; the mixtures presumably contained immunoreactively equivalent proportions of Au antigen and antibody. RIA data for diagnostic specimens indicated an end-point sensitivity which was proportional to the dilution of the standard anti-Au sera used in the test. High concentrations of the standard antibody permitted detectable inhibition of ^{125}I-Au antigen precipitation at lower antigen specimen concentrations. Similarly, low concentrations of the standard antibody permitted detectable enhancement of ^{125}I-Au antigen precipitation at lower antibody specimen concentrations. Omitting the standard antibody altogether resulted in a more sensitive RIA for Au antibody in test sera. (auth)

MATERIALS

3792 (AD-779943) MATERIAL SELECTION AND TESTING FOR THERMAL RADIATION SHIELDING. Vondersaar, F. J. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Mar 1974. 79p. (GNE/PH-74-9). NTIS $7.00.

Thesis.

The report includes procedures for selection and testing of advanced thermal protection materials for use on an absorptive, lightweight, thermal radiation flash shield to protect aircraft crews from a nuclear weapon thermal pulse. Included are a survey of thermal protection systems and materials, techniques for simulation of a nuclear weapon thermal pulse, testing procedures and equipment description, heat transfer theory and a computer code developed to model the flash shield. The code uses an implicit numerical solution method to solve the one-dimension, transient, heat conduction equation for a multilayer slab. Also shown in the report are results of testing and a final optimal shield design, with weight, cost, and safety information for the proposed shield. (GRA)

3793 A DEVICE FOR THE PREPARATION OF COMPOSITE CRYSTAL SAMPLES. Legrand, E.; Hautecler, S.; Vansteelandt, L. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Nucl. Instrum. Methods; 120: No. 1, 197-198(15 Aug 1974).

The determination of the dispersion relations for phonons and magnons by neutron inelastic scattering requires single-crystal samples. A device is described which allows to prepare large pseudo-single crystals by glueing on a plate several single crystal rods. Regular rocking curves for the composite crystals are obtained. (auth)

Ceramics and Cermets

Refer also to abstracts 2884, 3057, 3904, 5188, 5191, 5244, 5337, and 5338.

3794 (AD-779819) PROPERTIES OF CERAMIC MATERIALS. Summary Progress Report No. 24, 1 September 1972–31 August 1973. McGee, T. D. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). Aug 1973. Contract F33615-68-C-1034. 18p. (ISU-ERI-AMES-73210). NTIS $3.00.

Topics discussed include creep in ceramic materials; deformation of sodium chloride; diffusion and strength of ceramic oxide; adsorption isotherm studies; neutron activation analysis; ferroelectric materials; solid electrolytes; and acousto-electric device. (GRA)

3795 (AD-779946) PROPERTIES OF CERAMIC MATERIALS. Summary Progress Report No. 12, 1 September 1969–31 August 1970. McGee, T. D. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). Aug 1970. Contract F33615-68-C-1034. 119p. (ISU-ERI-AMES-84200; ARL-74-0080). NTIS $9.00.

Topics discussed include creep in ceramic materials; creep in sodium chloride; adsorption isotherm studies; diffusion and strength of ceramic oxides; activation analysis; barrier layer ferroelectrics; solid electrolytes; and acousto-electric devices. (GRA)

3796 (AD-779947) PROJECT THEMIS PROPERTIES OF CERAMIC MATERIALS. Summary Progress Report No. 16, 1 September 1970–31 August 1971. McGee, T. D. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). Mar 1971. Contract F33615-68-C-1034. (ISU-ERI-AMES-71048). NTIS $4.00.

Topics discussed include creep in ceramic materials; creep in sodium chloride; adsorption isotherm studies; diffusion and strength of ceramic oxides; neutron activation analysis; barrier layer ferroelectrics; solid electrolytes; and acousto-electric devices. (GRA)

3797 (AD-779954) PROPERTIES OF CERAMIC MATERIALS. Progress Report No. 20. McGee, T. D. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). 31 Aug 1972. Contract F33615-68-C-1034. 76p. (ISU-ERI-AMES-72219; ARL-74-0082). NTIS $4.00.

Discussions are presented on high-temperature ceramic materials group–creep in ceramic materials; creep in sodium chloride; diffusion and strength of ceramic oxides; composite materials group-adsorption isotherm studies; drawing glass fibers; neutron activation analysis; barrier layer ferroelectrics; solid electrolytes; and acousto-electric devices. (GRA)

3798 (AD–781214) NEW MATERIALS IN TECHNOLOGY. Belskii, E. I. 15 Mar 1974. Translated from pp 158-186 of Novye Materialy v Tekhnike, 1971. (FSTC-HT–23-318-73). 27p. NTIS $4.50.

The methods of powder metallurgy, consisting of compressing in one way or another and subsequently sintering, the products formed and their properties and uses are discussed. Metal powders and the various processes for pressing the products, and the sintering of cermet materials and the various types of articles produced from them are discussed. Cermet and hard alloy tools are discussed and properties and uses of various compositions are tabulated. Mineral ceramics, including quartz, emery, corundum, carborundum and boron carbide are discussed. Various cermets and their mechanical properties are given and the various types of diamonds and diamond-bearing tools, properties and purposes, are discussed. (GRA)

3799 (AD-781660) EFFECT OF OXIDES ON CERTAIN PROPERTIES OF GLASS CERAMIC COATINGS FOR TITANIUM. Sitnikova, A. Ya.; Borisenko, V. A.; Sudomoikin, I. A.; Shaitan, A. G.; Kukulevskaya, T. E. 19 Jun 1974. Translated by M. Olaechea from pp 189-199 of Vsesoyuznogo Soveshchaniya po Zharostoikim Pokrytiyam, 1972. (FTD-HT-23-1305-74). 17p. NTIS $3.00.

A study was conducted of the formability on titanium of coatings containing from 2 to 50% of one of the following oxides: SiO_2, Al_2O_3, ZrO_2, TiO_2, Cr_2O_3, MgO, CeO_2, $ZrSiO_4$, and on such properties of glass ceramic coatings as the coefficient of thermal expansion, impact resistance, chemical stability, heat resistance, and electrical resistance. (GRA)

3800 (AD-781739) ELECTRON TRAPPING IN ION-IMPLANTED SILICON DIOXIDE FILMS ON SILICON. Johnson, N. M.; Johnson, W. C.; Lampert, M. A. (Princeton Univ., N. J. (USA)). Jan 1974. Contract N00014-67-A-0151-0035. 81p. (PU-DPL-TR-27; AFCRL-TR-74-0133). NTIS $4.00.

Photoelectric and MOS capacitance – voltage techniques were used to investigate the properties of electron traps created in SiO_2 films by ion implantation. The samples consisted of MOS structures with either Al or Ne ions shallowly implanted into the oxide layer. Unannealed Al-implanted and Ne-implanted SiO_2 films possessed much larger concentrations of electron traps than were found in unimplanted control samples. The trapping centers introduced by the ion implantation were acceptor-like in that they acquired negative charge after capturing an electron, thereby giving rise to positive flatband voltages. From the existence of electron traps in Ne-implanted oxides, and from a substantial reduction in electron trapping after thermal anneal of Al-implanted samples, it is concluded that a large proportion of the traps are associated with displacement damage created by the ion implantation. In both Al-implanted and Ne-implanted oxides, photodepopulation of the electron traps required photon energies above 4.0 eV. (GRA)

3801 (AD-781995) EFFECT OF EUTECTIC MICROSTRUCTURES ON THE MECHANICAL PROPERTIES OF CERAMIC OXIDES. Final Report, 1 February 1969–31 December 1973. Hulse, C. O.; Batt, J. A. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). May 1974. Contract N00014-69-C-0073. 137p. (UARL-N-910803-10). NTIS $4.75.

Various experimental techniques for the production of unidirectionally solidified oxide eutectics were examined. These included a modified Bridgman–Starkbarger technique and bottom cooling of melts held in platinum crucibles. It was concluded that the best approach, at least for experimental purposes, was the floating molten zone technique and the successful use of a number of variations of this technique were demonstrated. Many different eutectic systems were directionally solidified and the mechanical properties of the $Al_2O_3-ZrO_2$ (Y_2O_3), $Y_2O_3-ZrO_2$, $CaZrO_3-ZrO_2$, and MgO–CaO systems are described in considerable detail. The strength results indicate that oxide materials prepared in this manner can exhibit exceptional strengths and significant increases in toughness at elevated temperatures. The various reasons and requirements for obtaining exceptional mechanical properties in this class of materials are considered. (GRA)

3802 (ANL-8107) TRITIUM RETENTION IN EBR-II-IRRADIATED BORON CARBIDE. Miles, C. C.; Wexler, S.;

Ebersole, E. R. (Argonne National Lab., Ill. (USA)). Jun 1974. Contract W-31-109-eng-38. 19p. Dep. NTIS $4.00.

The retention and loss of tritium from EBR-II-irradiated boron carbide were investigated. The tritium content of the irradiated samples, analyzed by chemical dissolution followed by liquid-scintillation counting, showed that essentially all the tritium produced by the nuclear processes is retained by the boron carbide. Rates of tritium evolution after irradiation were measured by heating samples in a carrier-gas stream and collecting the evolved tritium; rates of evolution were obtained as a function of temperature of the B_4C during the heat treatment, the time of heating, and the atmosphere surrounding the sample. The results reveal that tritium is substantially retained in B_4C at temperatures higher than those experienced by EBR-II high-worth control rods. However, considerable loss of tritium occurs at temperatures above 700°C. A theoretical model, based on the crystal structure of B_4C, the properties of the tritium-producing nuclear reactions, the mechanism of recoil slowing down and trapping, and posttrapping phenomena, is presented; the model qualitatively accounts for the observed retention and loss of tritium. (auth)

3803 (CONF-740833-2) INVESTIGATION OF EPR, TLD, AND TSEE OF BeO CERAMIC. Gammage, R. B.; Garrison, A. K. (Oak Ridge National Lab., Tenn. (USA); Emory Univ., Atlanta, Ga. (USA). Dept. of Physics). [nd]. 20p. Dep. NTIS $4.00.

From 4th international conference on luminescence dosimetry; Krakow, Poland (27 Aug 1974).

In several different types of irradiated ceramic BeO, the paramagnetic centers are Al^{2+}, F^{2-}, and impurity-related hole centers. For Brush Thermalox 995, annealing studies reveal that the prominent, single TL peak is associated with the decay of the Al^{2+} and the principal hole center. The most intense Al^{2+} resonance absorption and TL are obtained from the ceramic BeO with the highest aluminum content. The F^{2-} center (Consolidated BeO ceramic) plays an indistinct role in the appearance of an additional, intense TL peak. Its annealing behavior is very complex. None of the hole centers and few, if any, of the Al^{2+} centers (Thermalox 995) remain at temperatures where TSEE will occur. The centers responsible for TSEE remain unidentified. The TL and TSEE peaks are separated sufficiently in temperature to allow the TL to be read prior to and without affecting the TSEE signal. Thus, TSEE is useful as a backup for TLD; the dose can be remeasured at a subsequent time. The technique also permits discrimination between doses of penetrating (x and γ rays) and nonpenetrating (β and α particles) radiations incident on a single detector. (auth)

3804 (CONF-741002-P1, pp 14-22) VACUUM SINTERING AND HOT PRESSING OF Eu_2O_3. Pasto, A. E.; Martin, M. M.; Donnelly, R. G. (Oak Ridge National Lab., TN). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Fabrication of solid, dense cylinders of cubic and monoclinic Eu_2O_3 was investigated. It was found that the monoclinic form can be easily densified to 96% of theoretical with a grain size of about 20 μm. The procedure involves uniaxial pressing of cubic-phase powder to about 45% density, followed by sintering for 3 h at 1650°C in a vacuum of less than 10^{-4} torr. The low-temperature cubic form can be densified by vacuum hot pressing cubic Eu_2O_3 powder for 3 h at 6000 psi and 1000°C. The resultant pellets possess densities up to 92% of theoretical with a very fine grain size (probably less than 10 μm). The monoclinic form can be produced from cubic powder by vacuum hot pressing to densities greater than 99%, with a grain size of about 65 μm. This is accomplished by pressing at 6000 psi, first for 1 h at 1125°C, followed by 45 min to 1 h at 1300°C. In each case the use of vacuum results in a reduced oxygen stoichiometry, which can be restored by heating to 1000°C in air. Using the techniques described above, more than 300 cylindrical Eu_2O_3 pellets were produced for an irradiation experiment. These included cubic-phase pellets of two different sizes and monoclinic-phase pellets (both sintered and hot pressed) of two different sizes and three grain sizes. More than 100 smaller pellets were also produced for auxiliary testing. The only major difficulty involved was in obtaining the monoclinic-phase pellets at theoretical density by hot pressing. Theoretical density could not be obtained consistently in pellets with a length-to-diameter ratio greater than unity. These pellets were produced for the irradiation test at 94% density, and for other studies at 96 to 98%. Currently a study of the effects of various furnace atmospheres on the sintering behavior of monoclinic Eu_2O_3 is beginning. (auth)

3805 (CONF-741002-P1, pp 23-28) VACUUM HOT PRESSING OF Eu_2O_3. Stiglich, J. J. Jr. (Boride Products, Inc., Traverse City, MI). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Experience in working with Eu_2O_3 is described. Fabricability of this material is compared with that of B_4C. The fabrication work was accomplished using the two vacuum hot presses. Both presses develop 200 tons of force on verticle, opposed, hydraulic rams, and are capable of operating temperatures of 2500°C in a typical vacuum of 100 to 200 microns. The induction coils are powered by a 150 kW motor generator power supply and can receive graphite tooling measuring 20 inches in diameter by 24 inches high. Data and information on physical and structural properties of Eu_2O_3 pellets and plates are included. (JRD)

3806 (CONF-741002-P1, pp 36-45) BONDING AND SUPERCONDUCTIVITY IN THE Pu_2C_3 STRUCTURE TYPE. Carter, F. L.; Francavilla, T. L.; Hein, R. A. (Naval Research Lab., Washington, DC). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Bidirectional orbitals with f-orbital character are used to describe the Pu_2C_3 bond formation. It is shown that the use of f-orbital character in the bonding is further supported by the application of Pauling's metallic radii and polyhedral atomic volumes. The latter notion is akin to a Wigner-Seitz or Voronoi cell which is sensitive to the atom size. These considerations are combined to make suggestions relating bonding in the Pu_2C_3 structure to superconductivity. It is found that, while the previous experimental values of superconducting transition temperature (T_0) are supported, the critical field H_{c2} is significantly lower in the alloys investigated than in some members of the A15 structures with comparable T_0. (auth)

3807 (CONF-741002-P1, pp 139-148) ELECTRON OPTICAL STUDY OF STRUCTURE AND TEXTURE IN THE BINARY RARE EARTH OXIDES. Summerville, E.; Skarnulis, A. J.; Eyring, L. (Arizona State Univ., Tempe). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

The rare earth oxide systems belonging to the homologous series R_nO_{2n-2} ($4 \leq n \leq \infty$) are considered as representative of a broad class of fluorite-related materials to which the electron optical method should be applied. It is shown that it is possible to interpret the contrast of images of these oxide systems in terms of their structural details. Discussions are included on Pr_7O_{12} (iota phase), $Tb_{11}O_{20}$ (delta phase), and $Pr_{12}O_{22}$ (beta phase). It is noted that in the near future high resolution electron microscopy will provide much highly-detailed information on the crystallography of the ordered intermediate phases, the nature of transformation mechanisms and the mechanisms for accommodation of nonstoichiometry in the low-temperature phases. If the occurrence of disorder in the forms of polymorphy and twinning are as important as they appear to be, it seems unlikely that any other technique can provide the detail required for comprehension of the ordering phenomena exhibited in these systems. (JRD)

3808 (CONF-741002-P1, pp 149-156) CRYSTAL CHEMISTRY OF THE SCHEELITE SOLID SOLUTIONS IN THE SYSTEMS $SrMO_4-Eu_2(MO_4)_3$ AND $EuMO_4-Eu_2(MO_4)_3$ (M = Mo, W). Johnston, R. G.; McCarthy, G. J. (Pennsylvania State Univ., University Park). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Results of investigations of these systems by modeling the scheelite structure solid solutions in Eu_xMoO_4 using Sr^{2+} as a stand-in for Eu^{2+} are presented. Results are presented graphically and discussed. (JRD)

3809 (CONF-741002-P1, pp 157-165) PHASE RELATIONSHIPS IN THE CERIUM–MOLYBDENUM OXIDE SYSTEM. Bart, J. C. J.; Giordano, N. (Research Laboratories Montedison Petrochemical Div., Bollate, Italy). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

The system Ce–Mo–O was examined for ternary compound formation arising from the interaction of $Ce(NO_3)_3 \cdot 6H_2O$ and $(NH_4)_6Mo_7O_{24} \cdot 4H_2O$ between 500 and 850°C in air. By variation of the Ce/Mo ratio and the oxidation state of cerium, the following compounds were obtained: β-$Ce_2Mo_3O_{13}$, α- and β-$Ce_2Mo_4O_{15}$ and $Ce_8Mo_{12}O_{49}$ (formally $Ce_2Mo_3O_{12.25}$). The formation of the fundamental Ce-molybdates passes through several stages. At first, β-$Ce_2Mo_3O_{13}$ is formed (at 500°C), followed by α-$Ce_2Mo_4O_{15}$ (at 550°C), which undergoes an allotropic transformation at 675°C. The low temperature α-$Ce_2Mo_4O_{15}$ phase is isostructural with $La_2Mo_4O_{15}$. By interaction of α-$Ce_2Mo_4O_{15}$ with excess CeO_2 $Ce_8Mo_{12}O_{49}$ is formed at about 600°C. Part of the equilibrium diagram of the system $Ce_2O_3-MoO_3$ was established, in substitution of an earlier reported incorrect CeO_2-MoO_3 system [Ustinov et al., Russ. J. Inorg. Chem., 15, 1318 (1970)]. The present phase diagram agrees well with the La_2O_3-MoO_3 system. (auth)

3810 (CONF-741002-P1, pp 166-173) FORMATION OF DIVALENT EUROPIUM PEROVSKITES OF THE TYPE $EuMO_3$ AND $Eu(M,M')O_3$. Greedan, J. E. (Dalhousie Univ., Halifax, Nova Scotia); McCarthy, G. J.; Sipe, C. 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

As part of a study of the magnetic and optical properties of a series of materials containing divalent europium the preparation of a wide variety of perovskite structure materials of the types $Eu^{2+}M^{4+}O_3$ and $Eu^{2+}(M,M')^{4+}O_3$ was attempted. As a result of these efforts a number of new oxides of Eu^{2+} have been prepared and valuable information regarding the systematics of Eu^{2+}-crystal chemistry in oxide lattices has been gathered. (auth)

3811 (CONF-741002-P1, pp 174-183) PHASE EQUILIBRIA AND THE THERMODYNAMICS OF COEXISTING PHASES IN THE SYSTEM R–Fe–O (R = Ce, Pr, AND Eu). Tretyakov, Yu. D.; Sorokin, Vl. V. (Moscow State Univ.). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Results of a study of phase equilibria and the thermodynamics of coexisting phases in the system R–Fe–O, where R is Ce, Pr and Eu are presented. These elements have a variable valency and the character of ferritoformation depends on the oxygen chemical potential change in the equilibrium gaseous phase and temperature. It is of interest to study the cation nonstoichiometry of the intermediate phases in the system $Eu_2O_3-Fe_2O_3$ and identify the possibility of the solid solution formation with perovskite and garnet–type structure in the systems containing two rare earth elements (Eu–Ce–Fe–O and Eu–Pr–Fe–O). (auth)

3812 (JAERI-M-5681) EFFECT OF STRESS ON THE FORMATION OF URANIUM SESQUICARBIDE FROM URANIUM DICARBIDE. Kikuchi, A.; Ogawa, K.; Iwamoto, K. (Japan Atomic Energy Research Inst., Tokyo). Apr 1974. 15p. NTIS (US Sales Only).

Three kinds of uranium carbides, $UC_{1.87}$, UC_2–15 wt % U_2C_3 and UC_2–C, in the form of particles, were heated under compressive stress up to about 4,000 Kg/cm^2 below 1,450°C for up to 20 hrs. The formation of U_2C_3 resulting from UC_2 decomposition was detected quantitatively by x-ray diffraction analysis. The amount of U_2C_3 formed in the UC_2 increased with increase of the stress and the heating time. The maximum formation rate appeared at about 1,400°C, and the minimum stress required for its formation seemed to exist, about 600 Kg/cm^2. These results could be explained by an assumption that the formation was controlled by the rate of change of the lattice arrangement of uranium atoms in UC_2 into that of U_2C_3. It is considered that the plasticity of uranium carbides is related with the formation. (auth)

3813 (JAERI-M–5722) MIGRATION BEHAVIOUR AND FORMATION MECHANISM OF LENTICULAR VOIDS IN UO_2 PELLET. Kikuchi, A.; Tobita, T. (Japan Atomic Energy Research Inst., Tokyo). May 1974. 17p. (In Japanese). NTIS (US Sales Only).

UO_2 double pellets, composed of inner high density and outer low density UO_2, were prepared by sintering, and central heating experiments were performed for analyzing the migration behavior of lenticular voids. Furthermore, stress heating experiments were carried out to make clear the formation mechanism of the void, using special samples; as the result, stress-induced and evaporation-condensation mechanism is proposed. (JA)

3814 (LA-TR-74-25) BEHAVIOR OF POWDERS IN A PLASMA BEAM. Meyr. H. Translated from Ber. Deut. Keram. Ges.; 39: 115-124(1962). 29p. Dep. NTIS $4.50.

By restricting the width of an electric arc a plasma of high temperature can be produced. Recently the method was used for the melting and spray-application of materials with extremely high melting points. After a description of the operation of a plasma burner, the powder melting process in a plasma stream and a method for determining the optimum grain fraction and the most favorable spraying distance are discussed. Literature and experiments show that with a series of materials the sprayed layer is not identical with the original material. These changes can be either structural or caused by the thermal break-down or due to the chemical reaction between the gas used and the surrounding air. Conditions under which a change is to be expected are explained. (auth)

3815 (LA-UR-74-1205) CERAMICS FOR NUCLEAR APPLICATIONS. Stoddard, S. D. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 24p. (CONF-741102-1). Dep. NTIS $4.25.

From conference on engineering priorities in ceramic engineering and science; Alfred, New York, USA (6 Nov 1974).

A review is presented to indicate the wide variety of applications for ceramic materials in the nuclear industry. The ceramist scientist or engineer needs to understand that dramatic transitions are occurring in the nuclear energy field and he needs to understand the challenges they present. The ceramist's creative and inventive instinct is essential to the resolution of the problems associated with nuclear energy research and development. Many more ceramists should be at the front of this challenge. They must, and will, play a major role in establishing the deep and detailed technical understanding of the ceramic materials on which the economic future of nuclear power rests. The tasks are difficult and complex, requiring unprecedented interdisciplinary technological efforts and disciplined sound engineering developments to assure success. (auth)

3816 X RAY, NMR, AND DTA STUDY OF THE TaD_x SYSTEM AND A CRITICAL EVALUATION OF THE TaH_x PHASE DIAGRAM. Slotfeldt-Ellingsen, D.; Pedersen, B. (Central Inst. for Industrial Research, Blindern, Norway). Phys. Status Solidi (a); 25: No. 1, 115-124(16 Sep 1974).

The phase diagram of the TaD_x system is evaluated on the basis of x-ray diffraction, differential thermal analysis, and deuteron magnetic resonance measurements. The diagram is found to be nearly equal to a revised phase diagram of TaH_x. Besides the earlier known α- and β-phases, the existence of two new phase regions, possibly cubic, are proposed. The unit cell of the deuteride is found to be slightly larger than that of the hydride of the same composition. (auth)

3817 ELECTRICAL TRANSPORT PROPERTIES OF EuO SINGLE CRYSTAL IN RELATION WITH GROWTH PARAMETERS. Llinares, C. (Centre d'Electronique des Solides, Montpellier, France); Desfours, J. P.; Nadai, J. P.; Godart, C.; Percheron, A.; Achard, J. C. Phys. Status Solidi (a); 25: No. 1, 185-192(16 Sep 1974).

EuO single crystals have been obtained from different runs of growing. Electric conductivity, photoconductivity, and magnetoresistance measurements were made versus temperature and for magnetic fields up to 7 kOe. The study of the results was correlated to the growing parameters. In order to explain the two types of conductivities observed, a model of conduction is proposed with acceptor levels and two types of donor levels. (auth)

3818 MOESSBAUER AND ESR INVESTIGATIONS OF IRON VANADIUM OXIDE BRONZES. Baran, M. (Inst. of Physics, Warsaw); Polaczek, A. Phys. Status Solidi (a); 25: No. 1, K13-K15(16 Sep 1974).

Results of Mössbauer and ESR investigations of polycrystalline samples of $Fe_xV_2O_5$ with $x = 0.33$, 0.35, and 0.38 are presented. The samples were obtained by a reaction of iron powder with V_2O_5 at 640°C in vacuum. The x-ray powder pattern showed the same phase in all the samples and results of comparison with other data indicated that they have the θ-phase. Results show that the 4s iron orbitals may be used as conductivity electrons probably by interaction with the neighboring vanadium sites. (JRD)

3819 ELECTRICAL SWITCHING BEHAVIOR OF NIOBIUM OXIDE THIN FILMS. Bruchlos, H.; Manzel, M.; Steenbeck, K. (Institutsteil fuer Magnetische Werkstoffe, Jena, Ger.). Phys. Status Solidi (a); 25: No. 1, K39-K42(16 Sep 1974).

The electrical switching behavior of nonstoichiometric niobium pentoxide and niobium dioxide was studied. The unstable and non-reproducible switching processes observed in $NbO_{2.5}$ films after the electrical forming process are explained by the existence of a small channel consisting of oxygen depleted material. The temperature dependence of resistivity necessary for thermal switching is shown in pentoxide films reduced by 1% of their oxygen content. (JRD)

3820 ELECTRICAL AND THERMAL BEHAVIOR OF Gd–C ALLOYS IN THE NEIGHBORHOOD OF THE CURIE TEMPERA-

TURE. Milstein, F.; Baldwin, J. A.; Spingarn, J. (Univ. of California, Santa Barbara). Phys. Status Solidi (a); 25: No. 1, 107-114(16 Sep 1974).

The thermal coefficient of electrical resistivity α is determined experimentally for Gd and three Gd–C alloys in the neighborhood of their Curie temperatures. The resistivity coefficients are compared with previously published heat capacity data which were taken using the same four metals. There exists a remarkably high degree of similarity between the temperature dependence of the α's and of the heat capacities, including even the highest carbon content alloy, which behaves anomalously when compared with the other three metals. (auth)

3821 CALIBRATED DERIVATIVE THERMAL ANALYSIS APPARATUS FOR DETECTING PHASE TRANSITIONS IN HIGH TEMPERATURE MATERIALS. Rupert, G.N. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Rev. Sci. Instrum. 45: No. 9, 1127-1133 (Sept 1974).

The technique of derivative thermal analysis, dTA, which plots sample temperature vs rate of change of sample temperature, has been refined in this apparatus to produce calibrated derivative thermal analysis curves in units of degrees and degrees/second. The scaling factors of 1 K=2 mV and 1 K/sec =−100 mV permit calibration to 5273 K, materials permitting, with digital temperature readout. The derivative function provides high sensitivity for detecting very weak fast phase transitions by observing thermal arrests in linear heating and cooling curves. A companion automatic temperature controller holds the furnace temperature constant, or programs it up or down at a linear rate of 0.1 K/sec to 10 K/sec. Light from the incandescent sample and surrounding furnace is divided into two paths by a beam splitter. One path to an optical pyrometer provides temperature calibration. Light in the second path is sensed by photo transistors that measure the sample and furnace temperatures. The temperature signal is linearized by taking the logarithm of the photo transistor current. Operational amplifier circuits establish the desired proportionality to temperature. The sample and furnace temperature signals are differentiated to produce rate signals for dTA display and temperature control. Illustrative dTA curves of the U–C, Nb–C, and Nb–Al systems are included. (auth)

3822 URANIUM SELF–DIFFUSION IN STOICHIOMETRIC URANIUM MONOCARBIDE. Matzke, H.; Routbort, J.L.; Tasman, H.A. (European Institute for Transuranium Elements, EURATOM, D 75 Karlsruhe, Postfach 2266, Germany). J. Appl. Phys. 45: No. 12, 5187-5195 (Dec 1974).

Self–diffusion measurements, with ^{233}U as the tracer, have been obtained for stoichiometric arc–cast UC at temperatures between 1480 °C and the melting point and for zone–refined UC single crystals at temperatures between 1500 and 2125 °C. α spectroscopy was used to measure the α–energy degradation from which the diffusion profiles were determined. Conventional sectioning techniques were employed to determine the profiles at high temperatures. The results obtained from arc–cast UC yielded a curved Arrhenius plot. Computer programs were developed to fit the sum of two exponentials to the experimental data. This was accomplished by changing one or two of the parameters, $D_{0,1}$, $D_{0,2}$, ΔH_1, and ΔH_2, in steps and adjusting the remaining parameters to obtain the minimum standard deviation σ. The resultant equation was $D^U{}_{UC}=6.9\exp(-141000/RT)+3.6\times10^{-5}\exp(-84500/RT)$ cm^2 sec^{-1}. The data obtained from the single crystals showed a linear Arrhenius plot described by $D^U{}_{UC}=11.7\exp(-141900/RT)$ cm^2 sec^{-1}. The influence of impurities at low temperatures (—2100 °C) is the most probable cause of the curvature in the Arrhenius plot for the arc–cast UC. (auth)

3823 EFFECT OF VERY FAST QUENCHING AND AGING ON THE STRUCTURE AND A NUMBER OF PROPERTIES OF ALLOYS OF NIOBIUM–TUNGSTEN–ZIRCONIUM (HAFNIUM)–CARBON. Savitskii, E. M.; Ivanova, K. N.; Revyakin, A. V.; Glyuzitskii, B. D.; Khandarov, P. A. (Inst. of Metallurgy, Moscow). Fiz. Metal. Metalloved.; 38: No. 1, 117-125(Jul 1974). (In Russian).

Various methods including electronoscopic and x-ray phase analysis were used to investigate the effect of zirconium and hafnium (up to 4 at. %), the rate of quenching (5×10^6 deg/s) and of aging (up to 1400°C) on the fine structure, phase composition, and microhardness of alloys of niobium–tungsten–carbon (up to 2 at. % C). With very rapid quenching the different effect of zirconium and hafnium on the formation of carbide phases was established. Alloys of niobium–tungsten–zirconium–carbon indicated a metastable ϵ-phase (Nb_3C_2) which is absent in alloys of niobium–tungsten–hafnium–carbon. The difference in microhardness and deformation of the alloys is connected with the formation of this carbide phase. The formation of the metastable ϵ-phase depends on the affinity of carbide-forming element for carbon. On aging rapidly-quenched alloys, dispersed monocarbides of zirconium and hafnium of the type MeC are formed of disklike or circular form depending on the alloying element. (SJR)

3824 X-RAY DIFFRACTION STUDY OF THE HEATED PRODUCTS OF NEODYMIUM OXIDE, YTTRIUM OXIDE, AND VANADIUM(III) OXIDE AT 1400°C. Shin-ike, T. (Osaka Dental Coll., Hirakata, Japan); Adachi, G. Y.; Shiokawa, J. Nippon Kagaku Kaishi; 1974: No. 6, 1038-1042(Jun 1974). (In Japanese).

The heated products of Nd_2O_3, Y_2O_3, and V_2O_3 at 1400°C in vacuo (~ 10^{-4} mmHg) for an hour were studied through an analysis of x-ray diffraction patterns. In the case of the Y_2O_3–V_2O_3 system, only a stoichiometric perovskite type mixed oxide (YVO_3) was formed. In the case of Nd_2O_3–Y_2O_3, a crystal belonging to C-type (Sc_2O_3-type) was formed, if the mole fractions of Y_2O_3 in the reaction mixtures were above 0.65, and mixtures of both A-type (La_2O_3-type) and B-type (Sm_2O_3-type) compounds were formed, if the mole fractions of Y_2O_3 were less than 0.40. When Nd_2O_3, Y_2O_3, and V_2O_3 were heated together, lattice constants of the obtained perovskite type crystals were proportional to the mole ratios of Nd_2O_3 to Y_2O_3, if moles of $Nd_2O_3 + Y_2O_3$ were equal to moles of V_2O_3. If moles of $Nd_2O_3 + Y_2O_3$ were more than those of V_2O_3, Nd_2O_3 was incorporated more easily than Y_2O_3 into the perovskite type crystals. (auth)

3825 COMPLEX BORIDES IN PLATINUM METALS. Rogl, P.; Benesovsky, F.; Nowotny, H. Monatsh. Chem.; 103: No. 4, 965-989(1972). (In German).

The crystal structures of $W_2Ir_3B_{6-x}$ ($x\approx1$) and Mo_2IrB_2 were derived by means of single crystal photographs. $Mo_{2.5}Ir_{2.5}B_5$ is isotypic with $W_2Ir_3B_{6-x}$, but displays a more statistical distribution, however, of the two kinds of metal atom. In Mo_2IrB_2 there are B_4-groups present. (Cr, Ru)B as well as (Cr, Os)B crystallize with FeB-type structure, (Mo, Ru)B with CrB-type structure, and $(Mo, Ru)_3B_4$ is isotypic with Ta_3B_4. The principles of the structural chemistry of binary and ternary borides within the range of 40 to 60 at.% are discussed. (Metals Abstr.)

3826 RARE-EARTH MONONITRIDES AND NITRIDES WITH HIGHER NITROGEN CONTENT. Kieffer, I. R.; Ettmayer, P.; Pajakoff, S. Monatsh. Chem.; 103: No. 5, 1285-1298(1972). (In German).

All rare-earth metals (with the exception of Pm and Y) were nitrided with NH_3 and N. The NH_3 and N of normal pressure yield pure and stoichiometric mononitrides. Nitrogen of higher pressure (30 and 300 atm) results in the formation of nitrides with higher N content. In the case of Ce, Pr, and Nd compounds with a SEN_2 stoichiometry (SE = rare-earth metal) an x-ray powder pattern similar to that of the La_2O_3-type can be observed. Higher nitrides of the metals Tb, Dy, Ho, Tm, and Lu give powder patterns of the cubic Mn_2O_3-type. The precise composition of these latter nitrides could not be determined. (Metals Abstr.)

3827 MATHEMATICAL MODEL FOR THE CONDENSATION OF MoO_3 FROM A GAS STREAM WITH THE DISTRIBUTION OF PARAMETERS BEING TAKEN INTO ACCOUNT. Belyaevskaya, L. V.; Vaskevich, A. D. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 102-108(1974). (In Russian).

It has been shown that MoO_3 can be condensed as a supercooled liquid which then crystallizes without losing its spherical form which can be more readily handled by powder metallurgy methods. This condensation of MoO_3 to liquid drops is modeled mathematically for a gas stream with the following assumptions: 1) constant tube cross-section; 2) steady-state conditions of the process (vapor concentration, number of drops and size distribution are constant at each cross-section of the tube); 3) the growing liquid drops are a non-interacting system of particles; 4) temperature is homogeneous; 5) the drops move along the tube at the same speed as the gas flow. The full set of equations of the mathematical model of condensation to the liquid state are presented. (SJR)

3828 STUDY OF MOLYBDENUM ADSORPTION BY MEANS OF INFRARED SPECTROSCOPY. Kholmogorov, A. G.; Nadol'skii, A. P.; Pilipchuk, Yu. S. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 109-113(1974). (In Russian).

Molybdenum was adsorbed onto an anion resin having a macroporous structure (AV-17 type) from alkaline solution (ph of 8.5) and from acid solutions. The resin was then subjected to infra-red spectroscopy. A study of the spectra showed that absorption of Mo takes place in the form of the anion MoO_4^{2-} from alkaline solution, and in the form of polyanions $Mo_7O_{24}^{6-}$, $Mo_4O_{13}^{2-}$ and $HMo_4O_{13}^{-}$ from acid solutions having a pH of 1.5 to 5.5. Capacity of the anion resin or Mo decreases sharply with decreasing pH. (SJR)

3829 STRENGTH AND THERMAL STABILITY OF COMPOSITES OF ALUMINUM OXIDE–MOLYBDENUM FIBERS.

Akimenko, A. I.; Somov, A. I.; Yarovoi, V. G. Fiz. Khim. Obrab. Mater.; No. 4, 144-146(1974). (In Russian).

The results of a study of the bending strength of aluminum oxide reinforced with continuous Mo fibers were reported. The dependences of the strength on the volume content and diameter of the fibers were determined. The effect of thermal shocks on the strength characteristics of pure and reinforced ceramics was determined. (tr-auth)

3830 STUDY OF PHASE EQUILIBRIA AND STRUCTURE IN Ni–ZrC AND Ni–HfC ALLOYS. Dmitrieva, G. P.; Shurin, A. K. (Inst. of Metal Physics, Kiev). Metallofizika; No. 53, 97-100(1974). (In Russian).

By the methods of metallographic, x-ray, and differential thermal analyses of cast and annealed alloys the quasibinary cuts of Ni–ZrC and Ni–HfC were constructed in the ternary phase diagrams of Ni–Zr–C and Ni–Hf–C. These cuts belong to a eutectic type. The monocarbides ZrC and HfC respectively are in equilibrium with α–Ni. The temperature of eutectic equilibrium on the phase diagram of Ni–ZrC is equal to 1290 ± 20°C; the eutectic alloy contains 6 mol % ZrC. The eutectic equilibrium temperature on the Ni–HfC phase diagram is equal to 1330 ± 20°C; the composition of the eutectic alloy corresponds to 5.6 mol % HfC. (SJR)

3831 PHASE COMPOSITION OF CAST Nb–Zr–N ALLOYS AT THE SOLIDUS TEMPERATURE. Ban'kovskii, O. I.; Moiseev, V. F.; Pechkovskii, E. P.; Trefilov, V. I. (Inst. of Metal Physics, Kiev). Metallofizika; No. 53, 103-109(1974). (In Russian).

By the methods of optical electronmicroscopic, x-ray and phase analyses, and by determining the microhardness, a study was made of the phase composition of alloys in the Nb–Zr–N system. A solid solution of α-Nb at the solidus temperatures of the alloys is in equilibrium with ZrN, Nb_2N and α–Zr. The solubility of nitrogen in niobium at high temperatures decreases significantly on introducing zirconium. The phase diagram which was constructed can be used to determine the compositions of three-component Nb–Zr–N alloys having a given structure, and also to predict the properties of these alloys. (SJR)

3832 TRANSPORT PROPERTIES OF LIQUID ALLOYS $AgSbTe_{2-x}Se_x$. Nguyen van Dong; Lefort, P. J. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Status Solidi(a); 25: No. 2, 535-540(16 Oct 1974).

Electrical conductivity and thermoelectric power measurements have been performed on alloys $AgSbTe_{2-x}Se_x$ in the liquid state up to 240°C above their melting point as a function of temperature and composition. The Hall mobility has been measured for two extreme compositions ($x = 0$, $x = 2$). It is found that the activation energy calculated from conductivity data is approximately the same as that deduced from thermoelectric power data and increases with the content of Se. For the majority of compounds, the magnitude of the conductivity preexponential term σ_0 is higher than 100 Ω^{-1} cm^{-1}, suggesting a conduction by holes excited in the extended states near the mobility edge. The transition from a semiconducting to a metallic behavior has been observed at high temperature in compounds rich in Te ($0 \leqq x \leqq 0.5$). For $AgSbSe_2$ in which Hall mobility is found to be small, conduction should be due to the contribution of two processes: holes excited into extended states near the mobility edge and holes excited into localized states at the top of the valence band. (auth)

3833 BAND STRUCTURE CALCULATIONS ON NONSTOICHIOMETRIC VANADIUM CARBIDES VC_x. Neckel, A.; Rastl, P.; Schwarz, K.; Eibler-Mechtler, R. (Technische Hochschule, Vienna (Austria). Inst. fuer Technische Elektrochemie). Z. Naturforsch., a; 29: No. 1, 107-124(Jan 1974). (In German).

14 figs.; 9 tabs.; 52 refs.

The energy bands were determined for some nonstoichiometric VC_x phases ($x = 0.87$; 0.833; 0.79; 0.75) using the so-called APW virtual crystal (VCA) approximation (APW stands for "augmented-plane wave" method). The potential is constructed from the self consistent potential instead of using atomic data. A more realistic scheme for occupying the states is suggested. An attempt is made to normalize the wave functions in order to obtain the charge distribution in the crystal. The (partial) densities of states corresponding to the quantum numbers n and l were computed using an LCAO interpolation scheme. The Fermi energy and the density of states at the Fermi level increase with decreasing carbon content. The charge-transfer from V to C and the ionicity of VC_x is calculated to decrease with increasing vacancy concentration. Results of x-ray emission and heat capacity measurements are discussed. (GE)

3834 MAGNETIC ARRANGEMENTS IN URANIUM COMPOUNDS WITH UGeTe-TYPE CRYSTAL STRUCTURE. Lorenc, J. (Univ., Wroclaw); Przystawa, J.; Zygmunt, A. Phys. Status Solidi (a); 25: No. 2, 637-644(16 Oct 1974).

Possible magnetic orderings in crystal structures of UGeTe-type (space group I4/mmm) are discussed in molecular field approximation by the method of Smart and in terms of magnetic groups theory. Stability conditions are presented on phase diagrams. (auth)

3835 EXOEMISSION PROPERTIES OF ZrO_2. Kortov, V. S.; Shifrin, V. P. (Ural Polytechnical Inst., Sverdlovsk, USSR). Phys. Status Solidi (a); 25: No. 2, 377-385(16 Oct 1974).

The optically stimulated exoelectron emission (OSEE) and thermally stimulated exoelectron emission (TSEE) spectra of ZrO_2 as well as the exoelectron energy spectra after excitation by electron bombardment were investigated. The role of oxygen vacancies in producing emission active centers of the oxide is shown. An exoemission mechanism based on the participation of non-stationary fluctuational states in Auger-transitions of electrons is proposed. (auth)

3836 VISCOSITY OF UO_2-BASALT MELTS. Leibowitz, L.; Williams, C.; Chasanov, M. G. (Argonne National Lab., IL). Nucl. Technol.; 24: No. 2, 234-237(Nov 1974).

Measurements were made of the viscosity of Columbia River basalt and basalt-urania melts containing up to 18 wt % UO_2 in the temperature range 1360 to 1960°C. A concentric cylinder-type viscometer was used. The combined data were fit by the equation $\log \eta = -3.659 + (9009/T) - 0.01325\ X$, where η is viscosity in poise, T is temperature in degrees Kelvin and X is the weight percent UO_2 in the melt. (auth)

Metals and Alloys

Refer also to abstract 5222.

3837 (CONF-741002-P1) PROCEEDINGS OF THE 11TH RARE EARTH RESEARCH CONFERENCE, OCTOBER 7–10, 1974, TRAVERSE CITY, MICHIGAN. Volume I. Sessions A Through J. Haschke, J. M.; Eick, H. A. (eds.). (Michigan State Univ., East Lansing (USA)). 1974. 521p. Dep. NTIS $13.60.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

A total of 162 papers were presented at the conference. A separate abstract was prepared for each of thirty-six papers selected by NSA scope. Three papers were previously abstracted in NSA. (JRD)

For abstracts of individual papers see: 3804–3811, 3873–3898, 3984, and 4356.

3838 OPYT NEITRONNOI VLAGOMETRII V CHERNOI METALLURGII. (Experience of Neutron Hygrometry in Ferrous Metallurgy). Smolyak, V. A.; Shcherbitskii, B. V.; Evseeva, N. T. Moscow; Atomizdat (1974). 64p.

Consideration is given to problems of developing, investigating and applying automatic equipment for routine control of moisture in solid and liquid refractory materials by means of neutron survey meters. Particular attention is devoted to describing automatic systems of controlling and regulating moisture of various materials fed to blast furnaces. Details are presented on adjusting and calibrating neutron moisture meters used to measure the water content of materials. Technical and economic problems encountered in the application of neutron moisture meters to ferrous metallurgy are discussed. 29 fig, 10 tables. (SJR)

Corrosion and Erosion

Refer also to abstracts 2772, 2884, and 5241.

3839 (AD-781666) PROTECTION OF CERTAIN BORIDES FROM OXIDATION IN AIR AT 1200 DEGREES. Sazanova, M. V. 24 June 1974. Translated by C. M. Barber from pp 173-181 of Vsesoyuznogo Soveshchaniya po Zharostoikim Pokrytiyam, 1972. (FTD-HT-23-1303-74). 17p. NTIS $3.00.

Work was performed to clarify the possibility of protecting titanium, zirconium, chromium, niobium, hafnium, tantalum, and molybdenum (Mo_2B_5) borides from oxidation in air at 1200 using glass-silicide coatings. (GRA)

3840 (AED-CONF-74-063-002) REACTIONS OF Nb–Zr ALLOYS WITH OXYGEN. Jehn, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart (F. R. Germany)). 1974. 7p. (In German). INIS.

From conference "gases in metals"; Darmstadt, F. R. Germany (7 Mar 1974).

Investigations on the determination of the solubility limit of oxygen in Nb−Zr alloys are described, along with investigations of the kinetics of the oxygen sorption. (INIS)

3841 (Y−1963) CALCULATIONS OF NONSPALLING ISOTHERMAL HYDRIDING RATES FOR URANIUM. Condon, J. B. (Oak Ridge Y-12 Plant, Tenn. (USA)). 29 Oct 1974. Contract W-7405-eng-26. 16p. Dep. NTIS $4.00.

Hydriding rates were determined for uranium samples under conditions whereby parabolic or nearly parabolic rates prevail. The model used to calculate these rates has no adjustable parameters, is in fair agreement with the literature data, and may be used to predict the hydriding rate for uranium at any temperature, pressure, and sample thickness provided product spalling does not occur. (auth)

3842 A POSITRON STUDY OF CORROSION AND VOIDS IN Mg-In ALLOYS. Lock, D. G.; West, R. N. (East Anglia Univ. (UK). School of Mathematics and Physics). Phys. Lett., A; 49: No. 2, 137-138(26 Aug 1974).

The observation of anomalous positron lifetimes and annihilation gamma ray angular distributions for some MgIn alloys foreshadows the subsequent macroscopic breakdown of the originally metallic specimens. (auth)

3843 EXPERIENCE WITH FERRITIC STEELS IN REACTOR SYSTEMS. Ellis, D. E. pp 1-12 of Low Carbon and Stabilized $2\frac{1}{4}\%$ Chromium 1% Molybdenum Steels. Metals Park, OH; American Society for Metals (1973).

From proceedings of the materials engineering congress; Cleveland, Ohio (19 Oct 1970).

Fifteen years of experience in the use of ferritic steels in Na reactor systems are reviewed, including basic studies of the effect of Na on unstabilized ferritic steels and stabilized ferritic steel alloy development and applications. Sodium corrosion characteristics, decarburization rates and mechanical properties are tabulated for various $2\frac{1}{4}$ Cr−1 Mo ferritic steels. Advantages of both low-C and stabilized ferritic steels are compared, particularly in regard to application in a prototype steam generator currently being fabricated as part of a fast breeder reactor program. (Metals Abstr.)

3844 OXIDATION BEHAVIOR OF THE ALIGNED LAMELLAR EUTECTIC ALLOY Ni_3Al-Ni_3Nb. Smeggil, J. C.; McConnell, M. D. (General Electric Co., Schenectady, NY). Oxidation Metals; 8: No. 5, 309-341(Oct 1974).

The oxidation behavior of the directionally aligned Ni_3Al-Ni_3Nb lamellar eutectic alloy has been examined as a function of lamellar spacing for two interlamellar spacings (1.7 and 3.3μ) in the temperature range from 600 to 1155°C. At the low and high temperatures examined, 600 and 1155°C, no dependency of the oxidation behavior on the interlamellar spacing is observed. However, in the intermediate temperature regime, 800 and 990°C, such a dependency is seen, with the finer spacing structure oxidizing more rapidly at 800°C and more slowly at 990°C. The oxide scale formed on these alloys is very complex and varies markedly as a function of oxidation temperature. The structure of the oxidized aligned samples and their thermogravimetric behavior during oxidation differ from the behavior reported for the cast alloys. (auth)

3845 OXIDATION OF Fe−Cr ALLOYS CONTAINING AN OXIDE DISPERSION OR REACTIVE METAL ADDITIONS. Wright, I. G.; Wilcox, B. A. (Battelle Columbus Labs., OH). Oxidation Metals; 8: No. 5, 283-301(Oct 1974).

The oxidation of an iron−16% chromium alloy containing a dispersion of yttria particles and of iron−16 to 18% chromium alloys containing small additions of yttrium or zirconium has been studied at 1100 and 1200°C in 100-torr oxygen. The yttria-containing alloy exhibited the excellent oxidation resistance usually associated with oxide-dispersion-containing alloys, having a thin, adherent, virtually iron-free scale which resisted the breakaway rapid oxidation behavior commonly found in Fe−Cr alloys in this composition range. Of the alloying additions intended to form a fine oxide dispersion during oxidation, only zirconium affected the oxidation behavior in a beneficial way, the scale on the yttrium-containing alloy being possibly less protective than that on the equivalent binary alloy. (auth)

3846 KINETICS OF DECARBURIZATION OF $2\frac{1}{4}\%$ Cr−1% Mo STEEL IN SODIUM. Krankota, J. L.; Armijo, J. S. (General Electric Co., San Jose, CA). Contract AT(04-3)-189. Nucl. Technol.; 24: No. 2, 225-233(Nov 1974).

Recent data and published data on the decarburization kinetics of $2\frac{1}{4}\%$ Cr−1% Mo steel in sodium from 800 to 1300°F were correlated by expressing changes in bulk carbon content of samples of different thicknesses and geometry as carbon loss per unit of surface area exposed to sodium. This parameter, when plotted as a function of the square root of time, produced straight lines consistent with the expected diffusion control of the decarburization process. New data from this investigation yielded a decarburization rate constant that was in excellent agreement with the correlation obtained from the published data. A design curve prepared from the correlation was used to predict the end-of-life carbon contents of typical steam generator tubes in sodium systems. (auth)

Preparation and Fabrication

Refer also to abstract 5311.

3847 (AD-780034) ELEVATED TEMPERATURE MACHINING OF HIGH STRENGTH ALLOYS. Summary Report. Schmidt, A. O. (Pennsylvania State Univ., University Park (USA)). Mar 1974. 39p. (RIA-R-TR-74-011). NTIS $3.25.

Hot-machining tests in turning, boring, and milling were conducted on AISI 4340, AISI 4150, and on manganese steel workpieces to improve the shaping of both conventional and difficult-to-machine alloys. The workpieces were heated during the machining operations by one of three methods, namely a sliding electrode, a TIG torch, and friction elements. Test tool materials were of various types of ceramics, tungsten−titanium carbides, titanium carbides, and titanium-coated carbides. Cutting force measurements were made using a three-component dynamometer. (auth)

3848 (AD-781133) RESEARCH ON METALLURGICAL SYNTHESIS. Final Report. Wilcox, B. A.; Hahn, G. T.; Jaffee, R. I. (Battelle Columbus Labs., Ohio (USA)). Jan 1974. Contract F33615-71-C-1679. 228p. (AFML-TR-73-238-PT-2). NTIS $6.00.

A research program is described consisting of various tasks on metallurgical synthesis, which are aimed at developing improved microstructures in metals and ceramics of interest to the air force. The tasks are considered 'next step' research, in that prior critical experiments have demonstrated the feasibility of a concept. The research was aimed at developing the potential usefulness of the basic concept, and to determine the circumstances under which it might be expected to operate. The tasks discussed deal chiefly with research on aluminum and titanium alloys, and to a lesser extent with ceramics. (GRA)

3849 (AD-781494) DEPOSITION PROFILES BY VAPORIZATION EXPANSION WAVE METHOD. Technical Report, June 1972−June 1973. Burden, H. S. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Apr 1974. 30p. (BRL-MR-2370). NTIS $3.25.

A scheme is presented for measurement of deposition profiles in electrically conducting materials, effective in an energy range in which the material is in the mixed liquid-vapor state. An oscillographic record of sensor resistance may be made to yield a plot of deposited energy as a function of depth in the sensor by use of a slow, vaporization-expansion wave model. The results of tests in copper and aluminum sensors are shown and steps to improve accuracy are discussed. (GRA)

3850 (AD-781790) LOW ABSORPTANCE METALLIC COATINGS FOR METALLIC SUBSTRATES. Final Report, 28 June 1972−15 January 1974. Kurdock, J. R. (Perkin-Elmer Corp., Norwalk, Conn. (USA)). Jun 1974. 81p. (AFWL-TR-74-28). NTIS $4.00.

The program resulted in producing the fabrication technology that is required for high-energy 10.6 micrometer laser programs now underway. Polishing and coating techniques for metallic substrates were developed and the deposition of metallic coatings to reproducibly create metal mirror surfaces with low absorptance of a wavelength of 10.6 micrometer was investigated. The basic task was one of expanding and transferring to metal substrates the technology developed by Bennett and Ashley for fused silica substrates. Metal substrates of molybdenum, TZM, and beryllium-copper were polished to a surface roughness of from 12 to 15 Å root mean square (RMS) and overcoated with ultra-high-vacuum silver and gold. Absorption coefficients obtained were as low as 0.0064. The basic finishing technique that is now employed is acid etch stress relieving and controlled grinding, modified conventional polishing techniques, sputtering of similar metallic film, and modified conventional polishing. (GRA)

3851 (AD-782625) POWDER METALLURGY SUPERALLOYS FOR GAS TURBINE ENGINES. Final Report, 2 January 1973−2 June 1974. Kortovich, C. S. (TRW, Inc., Cleveland, Ohio (USA)). Jun 1974. Contract N00019-73-C-0138. 75p. (TRW-ER-7743). NTIS $3.75.

A program was conducted to develop powder metallurgy techniques for the optimization of alloys for gas turbine blades. A unique process was used consisting of blending metastable carbides and Y_2O_3 with carbon free base alloy MAR-M-246 by attrition and consolidating this blend by hot extrusion. This was followed by heat treatments designed to solution the metastable carbides and to grow either a minimum ASTM No. 2-3 grain size or a columnar grain size followed by precipitation of discrete particle grain boundary carbides during aging heat treatments. Mechanical property results indicated that while the 1400°F tensile properties of the powder metallurgy alloys developed in the program were comparable to those for cast MAR-M-246, the 1900°F/15 ksi stress rupture properties were substantially below those for the cast alloy. Hot corrosion test results indicated that while the poor resistance of base alloy MAR-M-246 was improved by the addition of Y_2O_3 dispersoid, its resistance was still not comparable to other cast nickel-base superalloys. (GRA)

3852 (HEDL-TME-74-25) AUSTENITIC STAINLESS STEEL WELD MATERIALS. A Data Compilation and Review. Ward, A. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1974. Contract AT(45-1)-2170. 118p. Dep. NTIS $5.45.

Data on austenitic stainless steel weld materials was compiled and reviewed to provide a central data source for analysis of the effects of LMFBR service conditions on weld deposited metal. Mechanical property (tensile and creep-rupture) data in the HEDL Weldment Program is given in conjunction with a general review of weld metallurgy, including the role of ferrite, ferrite measurement, hot-cracking mechanisms, thermal effects and mechanical properties. Analysis of these data showed that: (1) Irradiation effects in weld materials are generally consistent with trends established for wrought stainless steels, but, due to the higher initial strengths, the weld metal tends to exhibit a lower damage accumulation rate. (2) A useful rule for welding structures intended for elevated-temperature service is that the weld-deposit ferrite levels be restricted to <10% and generally minimized to a degree consistent with preventing hot-microfissuring. Then mechanical properties of austenitic stainless steel welds depend largely on the austenite matrix rather than on the second-phase ferrite. (3) Specimens taken from multiple-pass weldments usually exhibit high tensile yield strength and low ductility compared to the wrought parent materials. Although the presence of ferrite may contribute a small strength increment, the major increase is due to weld-induced prestrain and residual stress. High tensile yield strengths and low ductilities are largely recoverable by post-weld annealing. (51 fig, 58 references) (auth)

3853 (NBS-SPEC. PUBL.-260-16) STANDARD REFERENCE MATERIALS: HOMOGENEITY CHARACTERIZATION OF NBS SPECTROMETRIC STANDARDS. IV. Preparation and Microprobe Characterization of W–20% Mo Alloy Fabricated by Powder Metallurgical Methods. Special Pub. (Final). Yakowitz, H.; Michaelis, R. E.; Vieth, D. L. (National Bureau of Standards, Washington, D. C. (USA)). Jan 1969. 32p. (COM-74-11062). NTIS $4.75.

The preparation and evaluation of the first NBS standard tested specifically from the beginning for application to electron probe microanalyzers is described. The standard designated SRM 480 is a tungsten–20 weight percent molybdenum alloy prepared by a powder metallurgy process. Based on the results of about 1500 determinations for both tungsten and molybdenum by electron probe microanalysis, the material was found to be of high homogeneity at about the micrometer level molybdenum was 2.5% and that for tungsten 1.5%. Correction of relative intensity ratios to obtain concentrations is discussed in terms of input parameter uncertainties such as mass absorption coefficients, and electron backscatter factors. It is concluded that SRM 480 should be a valuable addition to any microprobe laboratory doing quantitative analyses. (GRA)

3854 NEW WELDING METHODS USED IN THE USSR FOR THE CONSTRUCTION OF POWER PLANTS. Tschudakow, W. Schweisstechnik (Berlin); 23: No. 9, 399-402(Sep 1973). (In German).

Details are given of fabrication techniques (in particular pipe welding), materials used, (mild, low alloy, and high alloy CrNi steels), and welding processes which are reported to offer an alternative to manual metal arc (MMA) and gas welding. The welding procedures and equipment used in TIG (W inert gas) and CO_2 welding are described. The productivity level of CO_2 welding can be higher than that of MMA welding. (Metals Abstr.)

3855 ELECTROLYTIC PRODUCTION OF ALLOYS OF URANIUM WITH NICKEL IN MOLTEN SODIUM AND POTASSIUM CHLORIDES. Kazantsev, G. N.; Raspopin, S. P.; Skiba, O. V. Sov. At. Energy (Engl. Transl.); 35: No. 5, 1027(Nov 1973).

Translated from At. Energ. (USSR); 35: No. 5, 344(Nov 1973). This is a summary of paper No. 699/7249 with full copy held at TIC.

A description of U alloy electrolytic production is presented. Liquid alloys of uranium with nickel are produced by the electrolysis of molten chlorides of the alkali alkaline earth metals, containing oxygen-free chlorides of uranium, using metallic nickel as the cathode temperature of 800 to 900°C. Most uranium-rich alloys are formed at the maximum current density and substantial cathode potentials, corresponding to the deposition of pure uranium. The linear dependences found permit the selection of the conditions for the production of alloys with a set composition or the determination of the composition of an alloy under set conditions of electrolysis. (auth)

3856 LUBRICATING COMPOSITIONS ON DRAWING MOLYBDENUM WIRE IN VARIOUS ATMOSPHERES. Zhilkin, V. Z.; Zhukov, A. V. Tsvetn. Metal.; No. 7, 78-81(Jul 1974). (In Russian).

On drawing molybdenum wire with heating in a vacuum, inert gas, and in air a drilled surface is recommended as a lubricating aid. On using lubricants of optimum composition: 23% graphite, 67% ED5 and 10% toluene (drawing in air) and 25% MoS_2 and 75% K41 (drawing in vacuum) it is possible to increase significantly the degree of reduction per pass. (SJR)

3857 REMOVAL OF CARBON FROM MOLYBDENUM DURING ELECTRON BEAM MELTING. Chernov, V. S.; Busol, F. I.; Nam, B. P. Tsvetn. Metal.; No. 7, 66-67(Jul 1974). (In Russian).

It is shown that during electron beam melting of molybdenum it is possible to attain significant decarburization of the metal by introducing the refractory oxides Al_2O_3, MgO, ZrO_2, and TiO_2 into the charge. (SJR)

3858 SIGNIFICANCE OF DEFECTS IN WELDED STRUCTURES. Proceedings of the Japan-U.S. Seminar, Tokyo, Japan, October 15-19, 1973. Kanazawa, T.; Kobayashi, A. S. (eds.). Tokyo; University of Tokyo Press (1974). 427p. (CONF-731097-). $25.00.

From Japan-US seminar on significance of defects in welded structures; Tokyo, Japan (15 Oct 1973).

The two main themes which emerged from this seminar are the choice of an appropriate ductile fracture criterion for weldments and the use of full scale versus small scale tests in characterizing fracture of thick ductile plates. The current trend in the US is to use a simple extension of linear fracture mechanics or the J-integral, while the Japanese are committed to the COD approaches. Many of the Japanese papers presented in this seminar reported experimental and theoretical analyses of weldments by the COD approach and would thus provide valuable and practical information to US engineers concerned with ductile fracture. The other significant point of departure is Japanese efforts in full scale crack growth and fracture testing which is unmatched in any known US effort. Although the efficiency of such full scale testing can be argued, the abundance of test data in this Proceedings would provide those concerned with crack growth and fracture of large structures information not available from other sources. (SFL)

Properties, Structure, and Phase Studies

Refer also to abstracts 3219, 3798, 3814, 3820, 3821, 3982, 4822, 4844, 4845, 4857, 4861, 4862, 5223, 5270, and 5288.

3859 (AD-779858) HIGH-FIELD MAGNETIZATION AND COERCIVITY OF AMORPHOUS RARE-EARTH-Fe_2 ALLOYS. Clark, A. E. (Naval Ordnance Lab., White Oak, Md. (USA)). 11 Jul 1973. 17p. (NOLTR-74-47). NTIS $3.00.

High-field magnetization studies were made from 4°K to room temperature on rapidly sputtered $TbFe_2$, $DyFe_2$, and $SmFe_2$. At 4.2°K the magnetic moment resembles that of polycrystal samples, whereas at room temperature it is substantially lower. Huge coercive forces (20 to 30 kOe) were observed at 4.2°K. Partial crystallization of $TbFe_2$ from the sputtered amorphous state yields high-energy products and coercivities (>3 kOe) at room temperature. (GRA)

3860 (AD-779937) MECHANICAL PROPERTIES OF Ti–6Al–4V ANNEALED FORGINGS. Final Report, June 1971–October 1973. Cervay, R. R. (Dayton Univ., Ohio (USA). Research Inst.). Mar 1974. 32p. NTIS $3.25.

Tests were conducted to determine the mechanical properties of titanium 6Al–4V annealed forgings. Tensile, fracture toughness, and constant amplitude cyclic crack growth properties were obtained along with limited corrosion studies of fastener installations. The tensile properties were determined for three orientations and the fracture toughness properties for four orientations. Some of the tensile and fracture toughness specimens were subjected to a time-temperature exposure before being tested at room temperature. The mechanical properties of the annealed material were similar to those in the literature. The time-temperature exposure cycle slightly altered the mechanical properties of the material. The corrosion tests conducted on the fastener installations did not produce any cracking in the material under the test conditions. (GRA)

3861 (AD-780361) STUDY OF SURFACE TENSION OF TITANIUM ALLOYS USING THE METHOD OF MELTING IN A SUSPENDED STATE. Fogel, A. A.; Magnitskii, O. N.; Mezdrogina, M. M.; Bronzova, N. I. 24 May 1974. Translated by V. Mesenzeff from pp 80–85 of Voprosy Teorii Protsessov Litya, Kiev, 1969. 11p. NTIS $3.00.

The effects of certain rare-earth elements and rhenium on the surface tension of titanium were studied. The surface tension values of Ce, La, Nd, and Re, determined by calculation, are lower than those for titanium. (GRA)

3862 (AD-780799) INVESTIGATION OF MICROQUENCHED MAGNESIUM ZK60A ALLOY. Final Report. Isserow, S. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Apr 1974. 20p. (AMMRC-TR-74-7). NTIS $3.00.

The substantial improvement of tensile behavior and impact resistance of magnesium ZK60A alloy by microquenching was confirmed. Metallographic examination showed that much of the strengthening, observed to approach 20 ksi, is attributable to the unusually fine grain size in rods extruded from microquenched powder. The powder itself is not unusually fine-grained but seems to embody features that make the consolidated material highly responsive to cold working, recrystallization, and aging. The grain size of the consolidated rods can, with a reasonable value for the Hall-Petch constant, be shown to account for the strength increment relative to ordinary commercial material obtained by casting and working. The powder-derived material also contains a fine intermetallic precipitate. The powder-derived material showed a fracture mode in both tension and impact tests that strongly involves separation or debonding of parallel strands. This fracture occurs in steps, is slower than the ordinary shear fracture, and absorbs much more energy. (GRA)

3863 (AD-780820) FUNDAMENTAL CONSIDERATIONS IN THE DEVELOPMENT OF IMPROVED BERYLLIUM FOR MISSILE STRUCTURES. Final Report. Aronin, L. R. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). May 1974. 21p. (AMMRC-MS-74-6). NTIS $3.00.

Recent improvements in beryllium are discussed in terms of its basic deformation and alloying behavior. Recent advances in beryllium are attributable to three factors in addition to impurity control: (1) powder production by impact attritioning; (2) consolidation of isotropic material by hot isostatic compaction; and (3) development of plasma spraying as a consolidation technique. Properties attainable in these materials are discussed. Further evaluations of these materials under biaxial and dynamic load conditions are required. Fabrication and testing of structures under simulated load conditions are recommended. (GRA)

3864 (AD-780968) CRYSTALLINE FIELD EFFECTS IN INTERMETALLIC COMPOUNDS. Davidov, D.; Bucher, E.; Rupp, L. W. Jr.; Longinotti, L. D.; Rettori, C. (California Univ., Los Angeles (USA). Dept. of Physics). Sep 1973. 36p. NTIS $3.25.

Electron spin resonance of the rare-earth ions Ce (+3), Dy (+3), Er (+3) and Yb (+3) has been observed in various cubic intermetallic compounds. Experimental results indicate the ground states to be (a) gamma 7 for Yb (+3) in $LaPd_3$ (Cu_3Au structure), (b) gamma 8 for Er (+3) in LaSb, LuSb, LaBi and LuBi (NaCl structure), (c) gamma 7 for Ce (+3) in LaSb, (d) gamma 6 for Dy (+3) in LaSb, (e) gamma 6 for Yb (+3) in LaSb, (f) gamma 6 for Er in LaB_6 (CaB_6 structure). These data represent the first observations of anisotropic resonance and hyperfine structure in intermetallic compounds as well as the first observation of EPR of Ce (+3) in any metal. The observations are consistent with crystalline field parameters deduced from measurements of concentrated spin systems with the same structure, by means of other experimental techniques. Analysis of the crystalline field parameters in terms of the point charge model, the virtual bound state model and possible F-like contributions is given. (GRA)

3865 (AD-781065) REVERSE LOADING EFFECTS IN BEND TESTS ON HOT ISOSTATICALLY PRESSED (HIP) BERYLLIUM. Final Report, November 1972–June 1973. Nicholas, T.; Sever, M. J. (Air Force Materials Lab., Wright-Patterson AFB, Ohio (USA)). Mar 1974. 31p. (AFML-TR-73-258). NTIS $3.25.

Results of four-point bend tests on two grades of hot isostatically pressed (HIP) beryllium are presented. Both one-directional and reversed loading were used to evaluate the effects of precompression on the subsequent tensile strain to failure. Additional tests on wide-bend specimens were used to evaluate the response of beryllium in bending under plane strain conditions. Stress–strain curves calculated from the results of bend tests indicate that flow stresses are higher than those obtained from uniaxial tension tests. (GRA)

3866 (AD–781248) INTERMETALS AND CONSTRUCTION MATERIALS BASED ON THEM. Popilov, L. Ya. 7 Oct 1972. Translated from pp 443-535 of Novye Materialy v Sudostroenie, Leningrad, 1966. (FSTC-HT–23-2309-72). 9p. NTIS $4.00.

Alloys such as titanium, beryllium and silicon, with nickel, carbon and bismuth have new properties of great importance for the construction industry. Their fire-resistant properties are outstanding. Tables list the most important properties of several beryllides and of titanium-nickel alloys. (GRA)

3867 (AD–781688) DYNAMIC MAGNETOELASTIC PROPERTIES OF RARE-EARTH MATERIALS. Final Report, 5 November 1971–30 November 1973. Donoho, P. L.; Brotzen, F. R.; Salama, K.; Huebell, W. C. (Rice Univ., Houston, Tex. (USA)). 30 Jun 1974. Contract DAAH01-72-C-0285. 75p. NTIS $3.75.

A summary of the goals and accomplishments of a research program on the dynamic magnetoelastic properties of rare-earth materials is given. Both elastic wave propagation and elastic-wave ultrasonic generation were investigated in pure rare-earth metals and in terbium-iron compounds. (GRA)

3868 (AD-781756) PRELIMINARY CREEP DEFLECTION DESIGN METHOD OF RADIATIVE METALLIC HEAT SHIELDS FOR ADVANCED AF VEHICLES. Memorandum Report (Final). Jansen, W. R. (Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio (USA)). Dec 1973. 72p. (AFFDL-TM-73-161-FBS). NTIS $3.75.

In support of their eventual AF development and use, an analytical investigation of the relative structural efficiency of radiative, coated and uncoated metallic heat shields for long life operation was conducted. The parameters required for establishment of qualitative performance characteristics for design of reusable heat shields were determined. An optimum weight prediction method was proposed based on the criterion of allowable aero-limited deflection as a direct effect of cyclic creep elongation of the material. Requirements at various temperature exposures were checked against the potential of existing different high temperature alloys on both a strength-to-weight and stiffness-to-weight competitive basis. The feasibility of the mathematical model developed for creep deflection evaluation of different heat shield configurations was partly proven by comparing estimated results and published test data of structural performance. (GRA)

3869 (AED-CONF-74-089-035) STATIC LATTICE GREEN'S FUNCTION AND ITS ASYMPTOTIC BEHAVIOUR FOR FCC AND BCC CRYSTALS. Schober, H. R.; Dederichs, P. H.; Mostoller, M. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Festkoerperforschung). 1974. 9p. INIS.

From spring meeting of the Arbeitskreis Festkoerperphysik of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

4 figs.; 3 tabs.; 19 refs. With abstract.

The static and elastic Green's functions are compared for Born–von Karman models of Cu, Al, Nb, and Li. If the spectrum for lower frequencies is determined by the small q-values only, the lattice Green's function agrees quite well with its elastic counterpart outside the effective range of the coupling parameters. This result is in contrast to earlier calculations which did not treat the Fourier integration near rho = 0 accurately enough. (auth)

3870 (AED-CONF-74-254-003) SUPERCONDUCTING SCREENING BODIES MADE OF Nb–Sn SINTER MATERIAL WITH HIGH CRITICAL CURRENT DENSITY. Lefranc, G.; Mueller, A. (Siemens A.G., Erlangen (F.R. Germany). Forschungslaboratorium). 1974. 5p. (In German). INIS.

From general meeting of the Deutsche Gesellschaft fuer Metallkunde e.V.; Bonn, F.R. Germany (4 Jun 1974).

7 figs. With abstract.

High-field superconductors offer the only possibility to obtain complete screening of high magnetic fields. Nb–Sn sinter material proved to be a suitable material where the Nb_3Sn phase determines the superconducting properties. The critical current density and thus the screening capacity is greatly influenced by the preparation, where above all, the starting material and the temperature conditions play a role. In particular, additions such as Cu, Ag, and Au are to be mentioned. The temperature of formation for the Nb_3Sn phase of the pure binary system of 930°C is reduced to 500°C by the addition of Cu, where the rate of formation is already considerable at this temperature. The effectiveness of the Cu addition is discussed with the help of the phase diagrams of the binary systems Nb–Sn and Cu–Sn. (GE)

3871 (BNWL-1863) TRANSMISSION ELECTRON MICROSCOPY OF PLUTONIUM. Busch, R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1974. Contract AT(45-1)-1830. 26p. Dep. NTIS $4.00.

Two approaches to the transmission microscopy of plutonium were examined. The first was primarily concerned with protecting the highly reactive plutonium thin foil from the atmosphere during transfer to the microscope and during observation in the microscope. Sandwiching the plutonium between thin layers (nominally 10 nm thick) of sputter deposited beryllium proved satisfactory. Observations of several plutonium alloys, sputter deposited to the desired thickness, were made. The second approach was an attempt to use a thinning method which would be compatible with the above protective layer scheme, to produce electron-transparent samples from bulk or thick sputter deposited plutonium. Ion thinning was the method selected, but problems such as inadequate focussing of the ion beam, and extremely low metal removal rates, prevented successful thinning. The coated foil specimens which were sputter deposited directly to an electron-transparent thickness (~20 nm) had no resolvable structure when first illuminated by the electron beam. Small grains started forming within a few seconds. These grains grew rapidly, while additional new grains appeared; these processes continued until the originally featureless matrix was consumed and occupied by new grains. The details of the crystallization differed somewhat between the alloys investigated. With the exception of unalloyed plutonium, the foils all ultimately developed the crystal structure expected in bulk sputtered deposits. The crystal structure of the unalloyed plutonium could not be established. During heating and cooling experiments after the initial crystallization the foils did not exhibit the phase transformations expected on the basis of their composition. Foils were slowly heated to an estimated 450°C in the microscope hot stage without visible changes in either the grain structure or the diffraction pattern. The absence of phase transformations may have been due to the dimensions of the foils, or possibly the effect of the protective beryllium layers. The discrepancies between thin foils and bulk sputter deposited plutonium, in both initial structure and subsequent phase transformation behavior, decrease the utility of the technique. The development of a suitable thinning technique is still required in order to gain useful structural information. (auth)

3872 (CONF-740669-1) INELASTIC NEUTRON AND X-RAY PHOTOEMISSION EXPERIMENTS ON USn_3. Lander, G. H.; Brun, T. O.; Veal, B. W.; Lam, D. J. (Argonne National Lab., Ill. (USA)). Aug 1974. 16p. Dep. NTIS $4.00.

From conference on crystalline electric field effects in metals and alloys; Montreal, Canada (26 Jun 1974).

Low-temperature susceptibility measurements on USn_3 indicate that the material does not order magnetically, and that the lowest crystal-field state is a nonmagnetic doublet or singlet with an excited state some 20 to 100°K above in energy. Neutron inelastic time-of-flight experiments were performed to search for the anticipated transitions between the crystal-field states. Spectra taken at 297 and 90°K show no sign of any discrete magnetic excitations. X-ray photoemission spectra from USn_3 show that the 5f electrons are located near the Fermi level so that strong hybridization between the 5f and conduction electrons probably occurs. (5 fig) (auth)

3873 (CONF-741002-P1, pp 46-52) INFLUENCE OF Tm AND Pr IMPURITIES ON THE SUPERCONDUCTING PROPERTIES OF La_3Al. Bergner, R. L. (Univ. of Pittsburgh); Mahoney, J. V.; Rao, V. U. S.; Sankar, S. G.; Duffer, P.; Obermyer, R. 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Observations of an increase in upper critical field (H_{c2}) over that in the parent compound La_3Al upon the addition of specific amounts of thulium impurity are reported. The results are interpreted as due to the combined influence of external and internal fields on the conduction electron spins. A low value found for the coefficient g_{eff} (exchange interaction between the rare earth and conduction electron spins) plus the existence of a nonmagnetic ground state in Tm makes possible the enhancement of Hc_2^* (value of the applied field which reduces the resistance to half the normal-state resistance) by addition of Tm to La_3Al. (JRD)

3874 (CONF-741002-P1, pp 53-62) ORIGIN OF "SOFT" MAGNETIC MOMENTS IN RARE EARTHS. Campagna, M.; Bucher, E.; Wertheim, G. K.; Longinotti, L. D. (Bell Labs., Murray Hill, NJ). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare research conference.

Chemically collapsed phases of SmS invariably show the coexistence of divalent and trivalent ions. The valence ratio observed by x-ray photoelectron spectroscopy (XPS) is in reasonable agreement with values inferred from systematics of the lattice constants. The nonmagnetic behavior of the 4f-shells can, in this case, be described by the model of Hirst [Hirst, Phys. Kond. Mat., 11:255(1970)]. In the Tm-monochalcogenides spontaneous interconfiguration fluctuations (ICF) are present at ambient conditions. While TmTe shows only paramagnetic behavior with $\theta_p \cong 0$°K, TmSe with $\theta_p = -33$°K demonstrates that, despite ICF, magnetic behavior can be observed. Following the model of Sicardi et al. (private communication), it can be inferred that in TmSe the Stoner criterion, $\rho_f(EF) \cdot U_{eff} > 6$, is fulfilled. Hund's rule correlations are well preserved within a 4f-shell showing ICF, demonstrating clearly that the mixing interaction with conduction electrons does not affect the ionic nature of the f-shell (auth)

3875 (CONF-741002-P1, pp 64-72) SPIN CORRELATIONS IN THE HEAVY RARE EARTH ALLOYS NEAR THE NEEL POINTS. Boyarsky, L. A. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

The magnetic susceptibility critical behavior steadiness with respect to local changes of the lattice periodic potential in rare earth alloys was investigated. Tb–Ho alloys (49 and 51 at. % Tb) and dilute Dy Fe alloys were studied. Results are tabulated and discussed. (JRD)

3876 (CONF-741002-P1, pp 73-81) STUDY OF ELECTRORESISTIVITY OF EUROPIUM METAL NEAR THE NEEL POINT. Dikovsky, V. Ya. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

The electroresistivity of 3 samples of Eu has been measured by the potentiometer method in the temperature region 4.2 to 300°K. The temperature gradients along the sample and the temperature instability during the measurements were less than 0.01 and 0.003°K respectively. Results are presented in graphs and tables and discussed. (JRD)

3877 (CONF-741002-P1, pp 82-89) PENETRATION OF ELECTRONS AND POSITRONS IN RARE EARTH METALS. Takhar, P. S. (Royal Military Coll., Kingston, Ont.); Gill, T. S.; Sehgal, M. L. 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

The straggling free ranges of electrons with E_{max} = 1.77, 1.71, 1.53, 0.77, 0.43 and 0.25 MeV were investigated in a number of metals including yttrium, neodymium, holmium, and ytterbium. The transmission through the same foils was also measured for positron with E_{max} = 1.89 MeV. These are first such measurements in rare earth foils. The experimental data on electron-positron relative transmission and different kinds of ranges in a number of metals including rare earth foils are presented. The mirror properties of positrons and electrons are described. (auth)

3878 (CONF-741002-P1, pp 115-123) THERMOPOWERS OF YTTERBIUM, SAMARIUM, AND HEAVY RARE EARTH METALS. Vedernikov, M. V.; Burkov, A. T.; Moreva, N. I. (Ioffe Physical-Technical Inst., Leningrad). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

New results of thermopower (TEP) measurements on Yb and other heavy rare earths are presented. Results are discussed and presented in graphs showing temperature dependence of the absolute TEP of Yb, Sm, Dy, Ho, Er, and Tm. Graphs are also included showing the generalized temperature dependence of the absolute TEP of rare earths and the temperature dependence of the resistivity and Hall constant for Dy. (JRD)

3879 (CONF-741002-P1, pp 133-138) STUDY OF $CeLnO_3$ AND $PrLnO_3$ COMPOUNDS. Coutures, J.; Coutures, J. P. (CNRS, Odeillo, France). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Properties of $CeLnO_3$ perovskite compounds are given (thermal stability, cell data) in this preliminary study. It can be seen for example that thermal stability is strongly dependent of the Ln^{3+} ionic radius. Physical properties (optical, magnetic, and electrical conductibility) are investigated. (auth)

3880 (CONF-741002-P1, pp 238-246) IMPURE RARE EARTH METALS. Jones, D. W. (Univ. of Birmingham, Eng.); Hukin, D. A. 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Data and information are presented on purification of rare earth metals. Discussions are included on the concept of purity, measurement of purity, and physical-chemical properties associated with purification processes. Purification methods are described and prospects for future rare earth research are summarized. (JRD)

3881 (CONF-741002-P1, pp 247-256) PART OF THE BIRTH AND EVOLUTION OF RARE EARTH MAGNETISM. Rhyne, J. J. (Naval Ordnance Lab., Silver Spring, MD). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Research progress on rare earth magnetism is reviewed. Data and information are included on properties of rare earths, magnetization and neutron diffraction, magnetic anisotropy, anomalous thermal expansion and magnetostriction, and transport properties. (JRD)

3882 (CONF-741002-P1, pp 308-316) NEUTRON CRYSTAL FIELD SPECTROSCOPY IN METALLIC RARE-EARTH SYSTEMS. Furrer, A. (Eidgenoessischen Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

The use of neutron inelastic scattering in investigation of rare earth crystal fields is described. Aspects of the crystalline electric field are discussed and experimental results for NdS and NdSe inelastic scattering are presented. Improvements in experimental techniques such as the use of J-mixing effects are described. (JRD)

3883 (CONF-741002-P1, pp 317-326) NEUTRON CRYSTAL FIELD SPECTROSCOPY IN THE INTERMETALLIC COMPOUNDS R–Rh (R = Tb, Ho, Er, and Tm). Rossat-Mignod, J. (CEN, Grenoble, France); Chamard-Bois, R.; Knorr, K.; Drexel, W. 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Results of a study of the crystal field in the heavy rare-earth-rhodium equiatomic system are presented. For these compounds two different crystal structures exist; the compounds involving La, Ce, Pr, and Nd crystallize with an orthorhombic structure (CrB type) while the series involving the other lanthanides crystallizes with the CsCl structure (B_2 type). The magnetic susceptibility shows crystal field effects at low temperatures and indicates that HoRh, ErRh, and TmRh order antiferromagnetically at 3.2, 3.3, and 2.7°K respectively whereas GdRh, TbRh, and DyRh are ferromagnets below 29.5, 19.2, and 4.8°K respectively. These compounds are appropriate to crystal field studies because the low ordering temperatures indicate that the exchange interactions should be small compared with the crystal field splittings. Results in HoRh showed that sharp crystal field levels can be expected. Results of inelastic neutron scattering on the compounds HoRh, ErRh, TmRh, and $Tb_{0.6}Y_{0.4}Rh$ in the paramagnetic phase are included. (auth)

3884 (CONF-741002-P1, pp 327-332) CALORIMETRIC STUDY OF MAGNETOCRYSTALLINE ANISOTROPY IN Dy_3Al_2. Sankar, S. G. (Univ. of Pittsburgh); Keller, D. A.; Inoue, T.; Craig, R. S.; Nereson, N. G. 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Dy_3Al_2 crystallizes in a tetragonal structure in which the magnetic atoms are divided into two sublattices with different easy axis of magnetization. Heat capacity measurements were performed in the temperature range 4.2 to 300°K. Three anomalies were observed peaking at 24.0, 68.0 and 93.0°K. The first peak appears to correspond to the rapid decrease in the $(BH)_{max}$ as the temperature is increased from 4.2 to 24°K. The two peaks at 68 and 93°K are interpreted in terms of the changes in the magnetic structures in two stages. These results are substantiated by a careful study of the neutron diffraction patterns. (auth)

3885 (CONF-741002-P1, pp 333-341) REVERSIBLE TEMPERATURE COEFFICIENT OF MAGNETIZATION OF Co–Sm–MM PERMANENT MAGNET ALLOYS. Martin, D. L.; Geertsen, J. G. (General Electric Co., Schenectady, NY). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Thermally controlled reversible magnetic rare earth materials were investigated. It was found that the replacement of samarium by misch-metal or praseodymium in Co_5R-type permanent magnet alloys results in a greater change of magnetization with increasing temperature. A 50% replacement increases the magnitude of the reversible temperature coefficient of magnetization about 20%. The sample-to-sample and batch-to-batch variations were not large but it was shown that variations of composition by changing the cobalt-to-rare-earth ratio or replacement of samarium by mischmetal or praseodymium resulted in an appreciable change in the reversible temperature coefficient. It seems likely that the composition effect is associated with a change in the Curie temperature which could shift the magnetization vs. temperature curve and therefore the temperature coefficient. (auth)

3886 (CONF-741002-P1, pp 342-352) PERMANENT MAGNET PROPERTIES OF Co–Sm–MM–Pr ALLOYS. Martin, D. L.; Geertsen, J. T.; Laforce, R. P.; Rockwood, A. C. (General Electric Co., Schenectady, NY). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

A study was conducted to develop lower-cost, high-performance cobalt rare-earth alloy magnets. It was a part of a broader program to establish manufacturing methods for making low-cost, high-performance motor magnets. The basic plan to achieve the combined goal of low-cost and high-performance was to use mischmetal and the direct reduction-of-oxide process to reduce the material cost, and to use samarium and praseodymium to maintain a high level of magnetic properties. As result of the study Co–Sm–MM alloy magnets containing 10% replacement of samarium by mischmetal have been made with the following properties: B_r 9200 > gauss, H_c 8900 oersteds, and $(BH)_{max} > 21$ MGOe. It has been demonstrated that the direct-reduction-of-oxide (R-D) base powder can be used successfully to make high quality Co–Sm–MM magnets. The combination of using some mischmetal and the R-D powder should lower the cost of the magnet powder. Scale-up of the powder preparation to 50 lb. batches was accomplished without any serious problems and with good batch-to-batch uniformity. (auth)

3887 (CONF-741002-P1, pp 353-360) MAGNETIC PROPERTIES AND STRUCTURES OF $Sm(Co, Cu, Fe)_7$ TYPE PERMANENT MAGNETS. Oiwa, I. T.; Honshima, M.; Kikuchi, E. (Shinetsu Chemical Co., Tokyo). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

The magnetic properties of Sm(Co, Cu, Fe) alloys prepared by vacuum induction melting of composition metals are presented. Data are presented on coercive force vs aging temperature, magnetic properties vs aging, magnetic properties vs copper content, and magnetic properties vs iron content. (JRD)

3888 (CONF-741002-P1, pp 370-381) SPECTROSCOPY OF 5f-SYSTEMS: ACTINIDES VS LANTHANIDES. Pappalardo, R. G. (GTE Laboratories Inc., Waltham, MA). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Spectral studies on gaseous actinides are reviewed insofar as they clarify the different chemical properties of actinides and lanthanides, and they provide the starting point in the interpretation of condensed-phase spectra. Of the latter spectra those of trivalent actinides in solution, single crystals and thin films have been extensively studied. The crystal potentials are of the same order of magnitude in trivalent actinides and lanthanides, while in the 5f-series the electronic repulsion parameters are smaller, and the spin-orbit coupling parameter is about twice as large as in the lanthanides. Among tetravalent actinides only the spectral properties of octahedrally-coordinated U^{4+} are well understood. The fourth-degree component of the crystal potential is in the latter roughly an order of magnitude larger than in trivalent lanthanides. The ionic versus covalent model for the crystalline splitting is briefly discussed in connection with the spectra of actinide cyclopentadienides. (auth)

3889 (CONF-741002-P1, pp 382-389) CRYSTAL FIELD IN SOME RARE EARTH COMPOUNDS. Gaume, F.; Linares, C.; Louat, A.; Blanchard, M. (Univ., Lyon). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Crystal field parameters for $LuVO_4(Eu^{3+})$ are calculated and compared with those of $YVO_4(Eu^{3+})$ and $YVO_4(Er^{3+})$. Crystal field in these vanadates is studied using the electrostatic, superposition and angular overlap models. The phenomenological parameters ($B^m_{n\,exp}$) of lutetium vanadate activated by europium were determined and the crystal field in this compound was resolved using a comparison with the yttrium vanadate. The crystal field can be approximated to an eight oxygen ligand surrounding so that the superposition model can be utilized. Nevertheless, the accuracy being not so good as usual, the crystal field may be considered to the limit of a ligand approximation owing to covalency bonds in the rare earth vanadates. The results of the angular overlap model agree with this hypothesis. (JRD)

3890 (CONF-741002-P1, pp 411-416) ATOMIC ENERGY LEVELS OF RARE EARTH ELEMENTS. Zalubas, R.; Hagan, L. (National Bureau of Standards, Washington, DC). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Work devoted to compilation of all known levels of free atoms and ions of La through Lu ($Z = 57$-71) is reported. Compiled data on lanthanide spectra show that there are now about 11,000 known energy levels, which were derived by classifying 84,000 lines from ~300,000 observed lines. These data were obtained from 350 references, indicating that a large number of people have worked on these spectra. A number of researchers are still working on them, and they, of course, deserve credit for the data. The list of references is too long to be given in this review, but they will be properly cited in the volume of atomic energy levels of rare earths. (auth)

3891 (CONF-741002-P1, pp 417-429) HYDROGEN IN RARE EARTH INTERMETALLICS. Buschow, K. H. J.; Kuijpers, F. A.; Miedema, A. R.; van Mal, H. H. (Philips Research Labs., Eindhoven, The Netherlands). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Aspects of H absorption in rare earths are discussed. Data and information are included on H absorption characteristics, magnetic properties of hydrides, and uses of rare earth hydrides. (JRD)

3892 (CONF-741002-P1, pp 430-438) MAGNETIC PROPERTIES OF THE SYSTEM $Th_{1-x}Y_x(Co_{1-z}Fe_z)_5$. Ganapathy, E. V.; Wallace, W. E.; Craig, R. S. (Univ. of Pittsburgh). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Results of an investigation to clarify the role of Co in controlling the magnetic properties of the system $Th_{1-x}Y_x(Co_{1-z}Fe_z)_5$ are presented. An analysis of results shows that a non-collinear structure may explain the observed behavior of these alloys. While the theory of random substitution of cobalt for Th appears reasonable, the observed behavior could be due to some other magnetic structure which changes to a ferromagnetic structure with an easy "c" axis at higher temperatures. Introduction of Y for Th or Fe for Co brings about a more nearly collinear ordering of the moments, causing the sudden increase in the observed value of saturation moment. Charge transfer, if any, appears to be insignificant. Further studies involving smaller substitution of Y and other rare earths for Th in $ThCo_5$ are in progress in an attempt to clarify these points. The results of these studies and the details of the anisotropy measurements will be reported later. (auth)

3893 (CONF-741002-P1, pp 449-450) TEMPERATURE DEPENDENCE OF MAGNETIC ANISOTROPY OF Er_2Co_{17}, Tm_2Co_{17}, AND Sm_2Co_{17}. Narasimhan, K. S. V. L. (Univ. of Pittsburgh); Wallace, W. E.; Hutchens, R. D.; Greedan, J. E. 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

The temperature dependence of the anisotropy field and the anisotropy constants were measured from 4.2 to 300°K for Er_2Co_{17}, Tm_2Co_{17} and Sm_2Co_{17}. Er_2Co_{17} has a maximum in the anisotropy field at 100°K, whereas Tm_2Co_{17} does not show a maximum. There are two rare earth sites, namely 2(b) and 2(d) in Er_2Co_{17} and Tm_2Co_{17}. The magnetic moments in the 2(b) sites lie in the plane, whereas in the 2(d) sites they lie along the c-axis. The direction of magnetic moments in Tm_2Co_{17} or Er_2Co_{17} is determined by a competition between these two sublattices, which is temperature dependent. The maximum in the anisotropy field comes about in this way. The stabilization energy was computed from point charge calculations and is compared with experimental results. Results on some substituted ternaries of Er_2Co_{17} and Tm_2Co_{17} are tabulated. (auth)

3894 (CONF-741002-P1, pp 451-459) MAGNETIC PROPERTIES OF $ThCo_{5-x}Ni_x$ COMPOUNDS. Narasimhan, K. S. V. L. (Univ. of Pittsburgh); Do-Dinh, C.; Wallace, W. E.; Hutchens, R. D. 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

A study was conducted to follow the variation in the anisotropy in the $ThCo_{5-x}Ni_x$ system as nickel is progressively substituted into the 2(c) sites. In addition, measurements of saturation moment, Curie temperature and lattice constants were made to better understand the nature of transition metal moment in these compounds. Results are presented in graphs and discussed. (JRD)

3895 (CONF-741002-P1, pp 461-468) MAGNETIZATION AND MAGNETOSTRICTION IN Lu_2Co_{17}, Tm_2Co_{17} AND $Lu_xTm_{2-x}Co_{17}$ INTERMETALLICS. Miller, A. E.; D'Silva, T.; Miura, K. (Univ. of Notre Dame, IN). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Results of a study on magnetization of single crystal spherical samples of Lu_2Co_{17}–Tm_2Co_{17} are presented. Data are presented on temperature dependence of saturation magnetization, field dependence of the magnetically induced strains in the basal plane, and field dependence of the magnetically induced strains in the $(1\bar{1}.0)$ plane. (JRD)

3896 (CONF-741002-P1, pp 469-476) MAGNETIZATION AND MAGNETIC ANISOTROPY IN $Y_xDy_{2-x}Co_{17}$ INTERMETALLICS. Miller, A. E.; Shanley, J. F. III; D'Silva, T. (Univ. of Notre Dame, IN). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

The studies were conducted using single crystal material grown by floating zone technique. Results are presented in graphs showing magnetization vs true field for Dy_2Co_{17}, magnetization vs true field for $Y_4Dy_{2-x}Co_{17}$ magnetization vs true field for $Y_4Dy_{2-x}Co_{17}$, saturation magnetization vs temperature for $Y_xDy_{2-x}Co_{17}$ magnetization vs direction in the A–B plane for $Y_4Dy_{2-x}Co_{17}$ and anisotropy constant vs temperature for $Y_xDy_{2-x}Co_{17}$ compounds. (JRD)

3897 (CONF-741002-P1, pp 477-486) MAGNETOCRYSTALLINE ANISOTROPY MEASURED ON SINGLE CRYSTAL $Y_2(Co_{1-x}Al_x)_{17}$ INTERMETALLICS. Hamano, M.; Yajima, S. (Tohoku Univ., Japan). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Results are presented of an investigation of the magnetic properties of the ternary $Y_2(Co_{1-x}Al_x)_{17}$ single crystals where only Co atoms are magnetic as well. The results are presented graphically and discussed. (JRD)

3898 (CONF-741002-P1, pp 487-494) EFFECT OF Tm AND Er SUBSTITUTION ON THE MAGNETIC ANISOTROPY OF $NdCo_5$ AND $PrCo_5$. Narasimhan, K. S. V. L.; Wallace, W. E. (Univ. of Pittsburgh). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

Results of a study are presented on the effect of Tm substitution on the anisotropy of $NdCo_5$. Measurements to $PrCo_5$ which also show an anisotropy change (at 105°K) are included. The anisotropy field for $Nd_{.6}Tm_{.4}Co_5$ was estimated to be 100 kOe and theoretical energy product of 21 M GOe at room temperature. $Nd_{.7}Tm_{.3}Co_5$ possesses a theoretical energy product of 29 M GOe. (auth)

3899 (COO-916-30) SOLID SOLUTION HARDENING OF THE TERNARY SYSTEM: Nb–Hf–W. Technical Progress Report, 1 January 1973–1 July 1974. Ruf, P.; Koss, D. (Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering). 1974. Contract AT(11-1)-916. 16p. Dep. NTIS $4.00.

Measurements of the yield stress as a function of the solute content are reported for a series of ultra-high vacuum degassed Nb–Hf–W single crystals tested at 900°K. The rate of hardening per solute addition increases as the total solute concentration becomes more concentrated. Although second phase precipitates are not expected and are not observed by transmission electron microscopy techniques, the yield stress of the concentrated Nb–Hf–W alloys is sensitive to heat treatment. A phenomenological analysis of the solid solution hardening of ternary alloys in terms of the binary alloy hardening increments is presented for the case in which the solute atoms have different strengths as obstacles to dislocation motion. Results of the analysis are the basis for predicting the observed strengthening at total concentrations of less than about 5 at. %, but the observed rate of hardening exceeds that predicted at total solute concentrations greater than approximately 5 at. %. The results are discussed in terms of a non-random solute distribution, sensitive to heat treatment, which is important in determining the yield stress at larger solute concentrations. (auth)

3900 (COO-916-31) THERMALLY ACTIVATED SOLID SOLUTION HARDENING OF THE TERNARY SYSTEM: Nb–Mo–W. Progress Report. Koss, D.; Hack, J. (Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering). 1974. Contract AT(11-1)-916. 12p. Dep. NTIS $4.00.

The temperature dependence of the flow stress of ultrahigh vacuum degassed Nb–Mo–W single crystals was investigated between 77 and 900°K. Tests of alloys containing up to 9.4 at. % (Mo–W) show that the thermal component of the flow stress exhibits little or no increase with increasing ternary solute content for most of the alloys tested. Solid solution softening is observed in the Nb–4.2 Mo–W alloys at 77°K. Results are interpreted utilizing a phenomenological analysis of the solid-solution hardening of ternary alloys in terms of binary alloy hardening increments. Analysis of the results suggests that a non-random solute distribution is responsible for reducing the thermal activated flow stress component, especially in concentrated alloys in which the Mo to W ratio is near unity. (auth)

3901 (IKE-1-1) ELECTRON BEAM WELDING AND STRENGTH TESTS ON MOLYBDENUM AND MOLYBDENUM ALLOYS. Schaefer, R.; Mayer, H. G.; Koeppe, A. (Stuttgart Univ. (TH) (F.R. Germany). Inst. fuer Kernenergetik). Apr 1974. 36p. (In German). (AED-CONF-74-195-009). INIS.

From 8th Plansee seminar: heat-resisting and wear-resisting sintered materials; Reutte, Austria (27 May 1974).

47 figs.; 11 refs. With abstract. Available from ZAED.

The weldability of different Mo alloys with the electron beam was investigated and the resulting ultimate stress values were compared with those of the non-welded material. The properties of the welded joint are essentially determined by the coarse-grained melting zone and a finer-grained heat-affected zone. The formation of these zones as well as the shape of the upper and lower bead can be influenced in limits by the extremely well manipulable and reproducible electron beam heat source. By doping sintered molybdenum with boron, hafnium, and carbon, welding properties are obtained which lie between those of pure Mo and TZM. The distribution of the alloy elements is finer and more even than in the non-welded material, the impurity concentration decreases in the melting zone. The deformability of the welded joint increases with temperature and partly exceeds that of the base metal. The hot tensile strengths of the welded samples at 1,300–1,500°C reached the values of the present base metal. By an immediate pre- and post-heat treatment of the welded zone with the electron beam, residual stresses caused by welding can be reduced. Regarding the construction it should be noted that the joint zones are placed where possible on thermally regularly stressed positions. (GE)

3902 (KFK-2034) TEMPERATURE DEPENDENCE OF THE FLUX-FLOW-RESISTANCE NEAR H_{c2}. Meier, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Aug 1974. 53p. (In German). Dep. NTIS (US Sales Only) $5.75.

Thesis. Submitted to Karlsruhe Univ. (West Germany). Fakultaet fuer Physik.

Measurements of the flux-flow-resistance ρ_f near H_{c2} were made on Pb–In alloys. Difficulty of measuring of ρ_f is discussed; a technique was developed to achieve reliable data. Results are compared with already existing theories of Schmid, Caroli and Maki, Thompson, and Takayama and Ebisawa. They confirm the theories of Thompson and Takayama and Ebisawa in the temperature region from $T/T_c = 0.2$ to 0.6. For $T/T_c > 0.6$, there are significant deviations and extrapolation to $t = 1$ seems to verify the result of Schmid. (19 figures, 39 references) (auth)

3903 (LBL-2756) CRYOGENIC TOUGHNESS THROUGH MICROSTRUCTURE CONTROL IN A FERRITIC Fe-Ni-Ti ALLOY. Jin, S.; Whitaker, B.; Morris, J. W. Jr.; Zackay, V. F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 25p. (CONF-740549-2). Dep. NTIS $4.25.

From symposium on properties of materials for liquid natural gas tankage; Boston, Massachusetts, USA (21 May 1974).

The selection of composition and processing of a ferritic Fe-Ni-Ti alloy having a favorable combination of strength and toughness at cryogenic temperature is discussed. Criteria on alloy composition lead to the choice of low interstitial Fe–12Ni–0.25Ti. The alloy naturally has a favorable microstructure, but cryogenic toughness must be imparted through grain refinement. Several alternate procedures are identified. Four of these are discussed in detail, along with the resulting tensile properties at 77°K, Charpy impact energies at 77°K and 5°K, and behavior in fracture toughness tests at 77°K. Alloys are obtained having yield strengths to 150 KSI with impact toughness to 5°K. (auth)

3904 (ORNL-4970) METALS AND CERAMICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1974. Peterson, S. (comp. and ed.). (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 89p. Dep. NTIS $5.45.

Research progress is reported on structure of materials, x ray diffraction, fundamental ceramics, crystal physics, surface phenomena, physical properties of materials, properties of superconductors, mechanical properties of materials, and radiation effects on materials. (JRD)

3905 (UCID-15970(Rev.1)) EVALUATION OF FRACTURE TOUGHNESS OF BERYLLIUM. Prado, M. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 May 1972. Contract W-7405-eng-48. 26p. Dep. NTIS $4.50.

Declassified 12 Jul 1972.

Fracture toughness and mechanical properties of hot-pressed beryllium are examined. The fracture toughness of Be was affected by both heat treatment and iron content. For material with an Fe/Al ratio of 6, the fracture toughness was about 10 ksi-in.^{½}, while for a 2.3 ratio the toughness was on the order of 14 ksi-in.^{½}. (auth)

3906 (WAPD-TM-1153) COMPUTER SIMULATION OF THE REDISTRIBUTION OF ALKALINE EARTH FISSION PRODUCTS IN FUEL RODS CONTAINING OXIDE FUELS (LWBR DEVELOPMENT PROGRAM). Marino, G. P.; Ocken, H. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Oct 1974. Contract AT(36-1)-Gen-14. 18p. Dep. NTIS $4.00.

Numerical techniques have been developed to treat the general problem of the redistribution of substitutional solutes of limited solubility under the action of a thermal gradient. The procedures have been used to simulate the redistribution of barium which is generated as a solid fission product and which has been observed to subsequently precipitate in the equiaxed regions of the oxide fuels used in fuel rods. Since the input parameters that are required for use in the analysis have not been experimentally determined, parameters have been inferred which would lead to the experimentally observed precipitation. (auth)

3907 SHORT-TIME CREEP OF NIOBIUM AND TANTALUM ALLOYS AT 2600 AND 3200°F. Perkins, R. A.; Wright, E. S. (Lockheed Palo Alto Research Labs., CA). J. Test. Eval.; 2: No. 5, 337-343(Sep 1974).

Uncoated Ta–17W and C129Y alloys and coated Ta–10W, C103, and C129Y alloys were evaluated. Time for creep strains of up to 2% was measured and results used to derive empirical equations that predict short-time creep life in this temperature range. The equations give estimates of the time-to-creep strains of up to 2% at stress levels that will produce the maximum strain in 60 min or less. Silicide-base coatings appear to add to the creep strength of coated Ta–10W but have little added effect on the strength of the Nb-base alloys. The creep behavior of coated metals can be analyzed by the same empirical methods as those used for uncoated substrates. Results show that commercially available silicide coatings protect the substrate from oxidation with creep strains of up to 2% on exposures of 1 to 1½ h in this temperature range. (auth)

3908 NUCLEAR ORIENTATION OF ^{160}Tb IN GOLD AND PALLADIUM. Perczuk, B.; Barclay, J. A. (Monash Univ., Clayton (Australia). Dept. of Physics). Phys. Lett., A; 49: No. 2, 175-176(26 Aug 1974).

The hyperfine interaction parameters were measured for ^{160}Tb in gold and palladium in the 100-10 mK temperature range using nuclear orientation. Good agreement between theory and experiment is found assuming the crystal field splitting gives $\langle J_z \rangle \sim 6$. (auth)

3909 TEMPERATURE DEPENDENCE OF THE VACANCY FORMATION ENERGY IN ALUMINUM AND POSITRON ANNIHILATION. Kim, S. M.; Buyers, W. J. L. (Atomic Energy of Canada Ltd., Chalk River, Ontario). Phys. Lett., A; 49: No. 2, 181-182 (26 Aug 1974).

Positron annihilation measurements in aluminum were analyzed assuming a temperature dependent vacancy formation energy E_f as suggested by Popovic et al. and Seeger. Because of a largely compensating variation in the entropy, the effect on the count rate is surprisingly small. (auth)

3910 QUANTUM OSCILLATIONS OF THE VELOCITY OF SOUND IN CADMIUM. Martins, J. M. V.; Missell, F. P. (Sao Paulo Univ. (Brazil). Instituto de Fisica). Phys. Lett., A; 49: No. 2, 163-164(26 Aug 1974).

Large amplitude quantum oscillations in the longitudinal sound velocity, $|\Delta V/V| \sim 10^{-3}$, were observed in cadmium. The oscillations were studied as a function of magnetic field up to 70 kOe and as a function of temperature in the region $1.5 \text{ K} \leq T \leq 4.2 \text{ K}$. (auth)

3911 ATOMIC VOLUME EXPANSION OF Ag + 52wt.% Cd ALLOY. Tonejc, A.; Tonejc, A. M.; Bonefacic, A. (Zagreb Univ. (Yugoslavia)). Phys. Lett., A; 49: No. 2, 145-146(26 Aug 1974).

The lattice constant and atomic volume expansion of an Ag-52 wt.% Cd alloy were measured from 17° to 560° using the X-ray technique. The atomic volume shows a discontinuity in transition from ordered bcc (B2) phase to hcp (A3) phase and a continuity in transition from hcp (A3) to disordered bcc (A2). (auth)

3912 γ-γ ANGULAR CORRELATION IN LIQUID ALLOYS. Tamaki, S.; Furusawa, A.; Watase, Y.; Okazaki, H. (Niigata Univ. (Japan)). Phys. Lett., A; 49: No. 2, 121-122(26 Aug 1974).

Gamma-gamma angular correlation functions $W(\theta)$ of In, In_2Bi, and InBi in their solid and liquid states were measured. The attenuation coefficients G_2 of liquid indium does not change with increase of temperature, whereas those of liquid alloys show some temperature dependences which are discussed in connection with a possible change of the extranuclear field gradient $(\partial^2 V/\partial z'^2)$. (auth)

3913 FAILURE TO OBSERVE COHERENT EFFECTS IN THE EXCITATION OF CHANNELED IONS. Berry, H. G. (Chicago Univ., Ill. (USA)); Gemmell, D. S.; Holland, R. E.; Poizat, J. C.; Remillieux, J.; Worthington, J. N. (Argonne National Lab., Ill. (USA)). Phys. Lett., A; 49: No. 2, 123-124(26 Aug 1974).

Measurements designed to detect effects due to coherent excitations of channeled ions first predicted and observed by Okorokov are reported. Such effects were not detected in measurements on both the optical emissions and the charge-state distributions of channeled helium and nitrogen ions transmitted through thin gold crystals. (auth)

3914 THE SPECIFIC HEAT OF TERBIUM BELOW 4K. Hill, R. W.; Cosier, J.; Hukin, D. A. (Oxford Univ. (UK). Clarendon Lab.); Wells, P.; Lanchester, P. C. (Southampton Univ. (UK). Dept. of Physics). Phys. Lett., A; 49: No. 2, 101-102(26 Aug 1974)

The heat capacity of two terbium specimens has been measured below 4 K and the results are in excellent agreement. The analysis yields an electronic coefficient of $\gamma = 4.35 \pm 0.1$ mJ mole^{-1} K^{-2} and a Debye temperature of 174 ± 1 K. (auth)

3915 NEUTRON AND X-RAY STUDY OF THE EFFECT OF HEAT TREATMENT ON THE STRUCTURE OF THE HEUSLER ALLOY Ni_2MnIn. Soltys, J. (Jagiellonian Univ., Krakow); Vanlaar, B.; Maniawski, F. Phys. Status Solidi (a); 25: No. 1, K43-K45(16 Sep 1974).

Results show that the disordering parameter for this alloy increases with cooling time from a value of zero for quenched specimens to 0.3 for samples annealed for 400 h; thus the atomic order decreases with cooling time. The mechanism of heat-induced ordering seems to be obscure. (JRD)

3916 PRECIPITATION OF HYDROGEN INTERSTITIALS IN SINGLE CRYSTAL TANTALUM. Westlake, D. G. (Argonne National Lab., IL); Wang, T. H.; Sundfors, R. K.; Fedders, P. A.; Bolef, D. I. Phys. Status Solidi (a); 25: No. 1, K35-K37(16 Sep 1974).

An explanation is presented of the complex nuclear acoustic resonance (NAR) absorption line for hydrogen charged Ta single crystals below 130°K. The temperature dependence of the NAR line is also explained. (JRD)

3917 EFFECTS OF A NONUNIFORM CURRENT DISTRIBUTION ON THE KINETIC INDUCTANCE OF A THIN SUPERCONDUCTING FILM. Baker, J.W.; Lejeune, J.D.; Naugle, D.G. (Texas A & M University, College Station, Texas 77843). J. Appl. Phys. 45: No. 11, 5043-5049 (Nov 1974).

Kinetic inductance measurements were used to probe the current uniformity in thin amorphous $Bi_{0.97}Tl_{0.03}$ films. Measurements were made on films having widths of 0.5 and 0.2 mm with thicknesses ranging from 300 to 2000 Å condensed on both quartz plates and Nb shield planes. The results for films without shield planes are compared to predictions based on approximate expressions for the current density in a thin film. The Nb shield plane appears to produce considerable smoothing of the current distribution. Measurements of the kinetic inductance of films on such a shield plane appear to provide a good method for the determination of the penetration depth in a-Bi. (auth)

3918 MEASURED FREQUENCY DEPENDENCE OF THE SURFACE RESISTANCE OF SUPERCONDUCTING NIOBIUM. Bauer, W.; Giordano, S.; Hahn, H. (Brookhaven National Laboratory, Upton, New York 11973). J. Appl. Phys. 45: No. 11, 5023-5026 (Nov 1974).

The surface resistance of a superconducting niobium cavity oscillating in the TE_{11n} modes has been measured over a frequency range from 1.7 to 7.8 GHz, and a frequency dependence proportional to $f^{2\pm0.1}$ has been found. This result differs from the $f^{1.7}$ dependence predicted by the approximate microscopic theory. A possible explanation for the observed anomaly is given by smearing of the density-of-states maximum due to inhomogeneities in the superconductor. (auth)

3919 PREPARATION AND PROPERTIES OF A MULTIFILAMENTARY V_3Ga COMPOSITE. Critchlow, P.R. (Institut de Recherche de l'Hydro-Québec C. P. 1000, Varennes, Québec, Canada); Gregory, E.; Marancik, W. J. Appl. Phys. 45: No. 11, 5027-5032 (Nov 1974).

The manufacture of a multifilamentary vanadium/gallium-copper composite and its subsequent heat treatment to form V_3Ga is described. The growth of the V_3Ga is discussed in terms of reaction time, temperature, and gallium concentration of the gallium-copper matrix. Superconducting transition temperatures and critical current densities are presented. Values of J_C, at 4.2°K and 80 kG, in excess of 5×10^5 A/cm^2 were observed. (auth)

3920 ELASTIC CONSTANTS OF SOME MAl_2 SINGLE CRYSTALS. Schiltz, R.J. Jr.; Smith, J.F. (Ames Laboratory-USAEC and Department of Metallurgy, Iowa State University, Ames, Iowa 50010). J. Appl. Phys. 45: No. 11, 4681-4685 (Nov 1974).

Elastic constants of single crystals of the cubic Laves phases $CaAl_2$, YAl_2, $LaAl_2$, and $GdAl_2$ have been measured over the temperature range 4.2 to 300°K. The ferromagnetic transition in $GdAl_2$ near 170°K is evident by changes in slope in plots of the three independently measured elastic constants of $GdAl_2$ as functions of temperature. Debye temperatures at 0°K were evaluated as 474°K for $CaAl_2$, 484°K for YAl_2, 374°K for $LaAl_2$, 399°K for magnetically disordered $GdAl_2$, and 406°K for magnetically ordered $GdAl_2$. It was inferred from the data that the valence electron distributions in nonsuperconducting YAl_2 and $GdAl_2$ are much alike, but the valence electron distribution in superconducting $LaAl_2$ is significantly different. Thus the results support a theoretical calculation indicating an admixture of 4f character into the valence bands of $LaAl_2$. (auth)

3921 MAGNETOCAPACITANCE EFFECT IN INDIUM ANTIMONIDE. Dobrovol'skii, V.N.; Ninidze, G.K. (T. G. Shevchenko Kiev State University). Sov. Phys.-Semicond. 8: No. 4, 532-533 (Oct 1974).

We have investigated the magnetocapacitance effect in a sample of n-type indium antimonide at a temperature of 77°K. This effect is studied as a function of magnetic field and is found to agree with that expected on the basis of the theory of the Hall effect. (AIP)

3922 KINETICS OF THE PHOTOCONDUCTIVITY AND PHOTOMAGNETIC EFFECT IN QUANTIZING MAGNETIC FIELDS APPLIED AT LOW TEMPERATURES TO n-TYPE INDIUM ANTIMONIDE. Lazarev, S.D.; Efremova, G.D. Sov. Phys.-Semicond. 8: No. 4, 474-477 (Oct 1974).

An experimental investigation was made of the kinetics of the photoconductivity and photomagnetic effect in degenerate samples ($n_0 = 6 \cdot 10^{14} - 10^{16}$ cm^{-3}) of n-type indium antimonide subjected to magnetic fields up to 27 kOe at temperatures of 1.7−12°K. The characteristic photoconductivity rise and decay times were governed by fast ($\tau_1 < 10^6$ sec) and slow ($\tau_2 \sim 10^{-4}$ sec) processes. The time constant of the slow process depended on the nature of the thermal contact between a sample and the ambient medium (when the constant was good the time constant became shorter), as well as on the magnetic field and impurity concentration. These factors did not affect the kinetics of the photomagnetic effect. A qualitative interpretation of the results obtained was based on the theory developed by Yassievich et al., which allowed for the influence of the nonequilibrium phonons on the photoelectric and photomagnetic phenomena. The causes of some discrepancies between the theory and experiment were considered. (auth)

3923 FLOW RESISTANCE AND ELECTRIC OSCILLATIONS IN FLUX−FLOW STATE OF Nb−25 at.% Zr WIRES. Matsunaga, S. (Japan Atomic Energy Research Institute, Oarai−machi, Ibaraki, Japan). J. Appl. Phys. 45: No. 12, 5422-5431 (Dec 1974).

The current−voltage ($I_s - V_s$) characteristics of Nb−25 at.% Zr wires with three kinds of strong pinning forces were measured in the region of magnetic field 15−62.4 kOe and temperature 1.95−5.5 °K, using a measuring method which controlled the catastrophic transition from the superconducting to the normal state by connecting a shunt resistor of a few micro−ohms with the sample. The $I_s - V_s$ characteristics of the sample with strong pinning force showed negative resistance. The negative resistance appears even in the region where Joule heat decreases with the increase of V_s, and it is strongly dependent on the strength of the pinning force rather than the temperature rise by Joule heat. This negative resistance is interpreted as being a negative flux−flow resistance, which appears when the pinning force is strong, as shown from the local model—a modification of the London model by pinning force. The abrupt change of V_s in the $I_s - V_s$ characteristics occurs when the absolute value of negative flux−flow resistance is smaller than the shunt resistance. The oscillations of I_s and V_s appear in the whole region of negative flux−flow resistance, and the fundamental frequency of I_s varies only by strength of the pinning force. The behavior of oscillations depends strongly on the pinning force, which, however, cannot be explained with usual theories. (auth)

3924 MAGNETIC FIELD PROFILES IN TYPE−II SUPERCONDUCTORS WITH PINNING USING A NEW AC TECHNIQUE. Rollins, R.W.; Küpfer, H.; Gey, W. (Institut für Experimentelle Kernphysik der Universität and des Kernforschungszentrums Karlsruhe, 75 Karlsruhe, Germany). J. Appl. Phys. 45: No. 12, 5392-5398 (Dec 1974).

A new ac technique is described which allows the experimental determination of the magnetic field profile near the sample surface in type−II superconductors with pinning. The technique, like a previous method of Campbell, depends only on the validity of the critical−state model and can separate the position and magnetic field dependence of the flux−pinning forces. The entire field profile is obtained from a measurement of the waveform of the response of the sample to a small ac magnetic field superimposed on the dc field. Profiles obtained in cold−worked Nb and Nb−Ti alloys are reported and the results compared with previous measurements. We have found that the critical−state model does not adequately describe the results obtained on the Nb−Ti alloys when the magnetic field is less than $0.5H_{c2}$. (auth)

3925 HIGH FIELD CRITICAL CURRENT DENSITIES FOR A THICK $Nb_{12}Al_3Ge$ SUPERCONDUCTOR MADE BY HIGH−RATE SPUTTERING. Dahlgren, S.D. (Battelle−Northwest, Metallurgy Development Department, Richland, Washington 99352); Suenaga, M.; Luhman, T.S. J. Appl. Phys. 45: No. 12, 5462-5463 (Dec 1974).

High current densities were measured for a 66−μm−thick sputter−deposited $Nb_{12}Al_3Ge$ superconductor in magnetic fields from 100 to 210 kOe. Critical currents at 4.2 °K were 2.5×10^5 A/cm² at 100 kOe, 1.3×10^5 A/cm² at 150 kOe, 2.6×10^4 A/cm² at 200 kOe, and 1.5×10^4 A/cm² at 210 kOe. The current densities were comparable to current densities reported for Nb_3Sn and V_3Ga. The deposit was made at a rate of 1 μm/min and heat treated 20 days at 750 °C prior to the current density measurements. (auth)

3926 BEHAVIOR OF THE ELEMENTS AT HIGH PRESSURES. Cannon, J.F. (High Pressure Data Center, 574 Lee Library, Brigham Young University, Provo, Utah 84602). J. Phys. Chem. Ref. Data 3: No. 3, 781-824 (Sept 1974).

Data on polymorphic phase changes and variation of melting temperature of the elements with pressure have been compiled and critically evaluated. Emphasis has been placed on work done at pressures exceeding 1 kbar. Pressure−temperature phase diagrams showing first−order solid−solid phase boundaries and/or melting curves derived from the best available data are given for 58 elements. Information on the crystal structures of high−pressure polymorphs is also reviewed. Those elements that exist in the gaseous state at room temperature and pressure are not included. (auth)

3927 IMAGE OF THE FERMI SURFACE AND SCREENING EFFECTS IN PHONON ATTENUATION. Huet, D.; Maneval, J.P. (Groupe de Physique des Solides, Ecole Normale Supérieure, 75231 Paris 05, France). Phys. Rev. Lett. 33: No. 19, 1154-1157 (4 Nov 1974).

Heat pulses transmitted into n−type InSb were detected by using superconducting diodes. By change of InSb doping, and by magentic tuning of the superconducting gap, a singularity in phonon attenuation was observed at twice the Fermi radius. The long waves, whose absorption is screened by the conduction electrons, are resolved by time−of−flight spectroscopy. (auth)

3928 ENERGY DISTRIBUTION OF SLOW POSITRONS DIFFUSING FROM INCOMPLETE d−SHELL TRANSITION METALS. Pendyala, S.; Bartell, D.; Girouard, F.E.; McGowan, J.W. (Department of Physics and Centre for Interdisciplinary, Studies in Chemical Physics, The University of Western Ontario, London, Ontario N6A 3K7, Canada). Phys. Rev. Lett. 33: No. 17, 1031-1034 (21 Oct 1974).

The energy distribution of slow positrons diffusing from chemically cleaned and partially outgassed polycrystalline tungsten, molybdenum, and chromium is made up of two principal parts, a broad asymmetric peak at 0.2±0.1 eV with a width of ~2 eV, and a second sharp, usually symmetric, peak with an energy which depends upon the material under study. The second peak is believed to be associated with the bulk properties of the material, in particular, with the electronic density of states. (auth)

3929 EVIDENCE FOR STRONG LOCALIZATION OF 5f ELECTRONS IN NEPTUNIUM INTERMETALLICS. Dunlap, B.D.; Lander, G.H. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 33: No. 17, 1046-1048 (21 Oct 1974).

The correlation between the magnetic hyperfine field H_{hf} and the electronic moment μ at the neptunium site in a number of neptunium conducting compounds is presented. A simple linear relation $H_{hf} = [(1915\ \mathrm{kOe})/\mu_B]\mu$ is found. This behavior is similar to that observed in lanthanide systems and suggests a strong localization of the 5f electrons in these materials. The implications of this result for our understanding of magnetism in the actinides are considered. (auth)

3930 MAGNETIZATION MOESSBAUER EFFECT AND SUPERCONDUCTIVITY IN Fe_2Te_3. Hermon, E. (McGill Univ., Montreal); Muir, W. B.; Quaroni, J.; Sweet, R. C. Can. J. Phys.; 52: No. 18, 1800-1804(15 Sep 1974).

The magnetization and Mössbauer effect in Fe_2Te_3 have been measured between liquid helium temperatures and 300°K and the Meissner effect has been studied between 1.7 and 4.2°K. Both the Mössbauer effect and the magnetization indicate that Fe_2Te_3 undergoes a weak ferromagnetic transition at about 10°K and has an internal field of 11 kOe at the lowest temperatures. The superconducting transition predicted by Atzeri and Mula was not observed. Above 10°K the temperature variation of the susceptibility is probably a reflection of the energy dependence of the d band density of states on the Pauli spin susceptibility of the material. (auth)

3931 EFFECTIVE QUASIPARTICLE LIFETIME IN SUPER-CONDUCTING Sn. Parker, W. H. (Univ. of California, Irvine). Solid State Commun.; 15: No. 6, 1003-1006(15 Sep 1974).

The effective quasiparticle lifetime in superconducting Sn has been determined from measurements on conventional oxide-barrier tunnel junctions biased at the energy gap and exposed to optical radiation. The result is in agreement with the value obtained by Sai-Halasz et al. (Phys.Rev.Lett.;33:215(1974)) from microwave surface impedance measurements. (auth)

3932 CRACK PROPAGATION IN THIN FOILS OF REFRACTORY METALS. Sarzhan, G. F.; Trefilov, V. I.; Firstov, S. A. (Inst. of Metal Physics, Kiev). Fiz. Metal Metalloved.; 38: No. 1, 76-82(Jul 1974). (In Russian).

Features of crack propagation and stopping were investigated in foils of refractory metals subjected to loading outside the electron microscope. The study was carried out on foils of chromium, molybdenum, tungsten, vanadium, and a 50% Fe−Cr alloy both in the deformed and also the recrystallized states. (SJR)

3933 KINETICS OF DIRECTED ORDERING IN NICKEL−IRON ALLOYS IN THE PROCESS OF IRRADIATION. Rogozyanov, A. Ya.; Lyashchenko, B. G. Fiz. Metal. Metalloved.; 38: No. 1, 110-116(Jul 1974). (In Russian).

Measurements were carried out on the kinetic dependencies of the constant of single-axial magnetic anisotropy induced during directed ordering of Fe−Ni alloys containing 69.4, 75.6 and 80.1 at.% Ni in the process of reactor irradiation at temperatures in the interval of 110 to 360°C. It was found that at temperatures not exceeding 310°C the effect of irradiation significantly exceeds the effects of ordinary thermal action. It is also shown that the experimental results can be explained by radiation-stimulated diffusion caused by migration of radiation vacancies and internodal atoms. (SJR)

3934 STRUCTURE OF PLASTICALLY DEFORMED ALLOY OF IRON–COBALT–VANADIUM. Dubovoi, A. G.; Zalutskii, V. P.; Nesterenko, E. G.; Chumachenko, V. K. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 38: No. 1, 126-131(Jul 1974). (In Russian).

Neutrongraphic and x-ray studies were carried out on the structures of ordered and disordered Fe–Co–V alloys. It was established that with deformation of ordered alloys by compression a decrease in size of antiphase domains and a decrease in degree of order take place. It is shown that the distortion in crystal structure of ordered alloys after plastic deformation is higher than that of unordered alloys. It is proposed that the decrease in degree of order during deformation of the ordered alloys is connected with the occurrence of unordered layering along the boundaries of the antiphase domains. (SJR)

3935 EFFECT OF POLYGONIZATION AND WORK RECRYSTALLIZATION ON THE INTENSITY OF X RAY REFLECTIONS AND THE MECHANICAL PROPERTIES OF DEFORMED TUNGSTEN. Mordyuk, V. S.; Mordyuk, G. P.; Kushta, G. P. (Chernovitsky State Univ., USSR). Fiz. Metal. Metalloved.; 38: No. 1, 156-160(Jul 1974). (In Russian).

On annealing deformed tungsten in the region of temperatures of polygonization and work recrystallization an experimental confirmation was obtained for the main conclusions of theoretical studies on the effect of the character of dislocation distribution on the regularity of scattering intensity distribution of x rays at Bragg maxima. It is shown in particular that the formation of a polygonal structure in tungsten is accompanied by broadening of x-ray diffraction lines and by a shift of the gaussian law of intensity distribution in the line profile to Lorentz. The data of the x ray studies is confirmed by the results of mechanical tests which indicate a substantial strengthening of the tungsten lattice because of the creation of a stable polygonal network of dislocations during annealing under load. (SJR)

3936 EFFECT OF COPPER ON PRISMATIC SLIP IN SINGLE CRYSTALS OF BERYLLIUM. Avotin, S. S.; Kapcherin, A. S.; Papirov, I. I.; Puar'e, Zh. P.; Tikhinskii, G. F. (Physical-Technical Inst., Kharkov). Fiz. Metal. Metalloved.; 38: No. 1, 183-190(Jul 1974). (In Russian).

A study was made of the effect of copper (0.23 and 1.34 at.%) on the prismatic slip of copper–beryllium alloys in the temperature interval of 77 to 823°K. For single crystals of the Be–0.23 at.% Cu alloy a maximum was detected near room temperature in the temperature dependence of the critical displacement stress. An increase in copper concentration to 1.34 at.% leads to a significant increase of $\tau_{(1010)}(T)$ and disappearance of the maximum on the $\tau_{(1010)}(T)$ curve. Prismatic slip of the Be–0.23 at.% Cu alloy in the thermally activated region ($T < 300$°K) is controlled by transverse glide from the prismatic plane to the basal plane, and at $T > 300$°K it is controlled by the interaction of moving dislocations with impurities according to the mechanism of Fleischer. In the Be–1.34 at.% Cu alloy, prismatic slip is controlled by the interaction of dislocations with impurities in the interval of 77 to 400°K. (SJR)

3937 TEMPERATURE DEPENDENCES OF THE LATTICE PARAMETER AND INTENSITY OF THE MAIN DIFFRACTION MAXIMA OF Fe–Mo, Fe–W, AND Fe–Nb SOLID SOLUTIONS. Val'chikovskaya, V. A.; Kushta, G. P.; Petropavlovskaya, Z. N. Fiz. Metal. Metalloved.; 38: No. 1, 198-200(Jul 1974). (In Russian).

The study was carried out on alloys with the following composition in wt %: 1) Fe; 2) Fe + 0.2 Nb; 3) Fe + 0.4 Nb; 4) Fe + 0.5 W; 5) Fe + 1.0 W; 6) Fe + 2.6 W; 7) Fe + 0.4 Mo; 8) Fe + 1.4 Mo. The rate of change of the thermal x-ray broadening α was found to decrease with increasing concentration of Mo, W, and Nb in comparison with pure iron with the greatest decrease being observed for Fe–Mo alloys. The value of α and the temperature dependencies show that anharmonic effects decrease with increasing concentration of the alloying component. Line intensities of diffraction maxima were determined and it is shown that the calculated characteristic temperature increases with increasing content of Mo, W, and Nb the more, the greater the concentration of the alloying impurity. The interatomic interaction is higher in Fe–Mo alloys than in Fe–W and Fe–Nb alloys. Niobium has a significant effect on the heat-strength properties of Fe–Nb alloys. (SJR)

3938 SVOISTVA RASPLAVLENNYKH METALLOV. Trudy XVI Soveshchaniya po Teorii Liteinykh Protsessov. (Properties of Fused Metals. Proceedings of the 16th Congress on the Theory of Foundary Processes). Gulyaev, B. B. (ed.). Moscow; Izdatel'stvo Nauka (1974). 184p.

About forty-nine papers are presented in the book. A separate abstract was presented for each of two papers selected by NSA scope. (JRD)

For abstracts of individual papers see: 3939 and 3940.

3939 EFFECT OF ADDITIONS OF MAGNESIUM AND CERIUM ON THE STRUCTURE OF PIG IRON. Davydova, S. G.; Lyubchenko, A. P.; Mozharov, M. V.; Petrichenko, A. M.; Sevenko, G. P. pp 152-155 of Svoistva Rasplavlennykh Metallov. Gulyaev, B. B. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

By x-ray studies of the phase composition of fractions extracted in various ways from high-strength pig iron it was established that the carbides MgC_2 and Mg_2C_3 and metallic magnesium are present in magnesium pig iron, and the compounds $CeFe_2$ and $CeFe_5$ are present in cerium pig iron. The desperoidizing effect of increased amounts of cerium or magnesium on the graphitic phase of pig iron, and the change in alloy microstructure with an increase in concentration of speriodizer (for magnesium pig iron from perlithic-cementitious to perlitic and perlithic-ferritic) can be explained by the formation of magnesium or cerium compounds with alloy components during crystallization (SJR)

3940 STUDY OF THE EFFECTS OF RARE EARTHS AND YTTRIUM ON THE CAST PROPERTIES OF STEEL. Gladkov, M. I.; Stasyuk, G. F.; Etelis, L. S.; Yakovlev, Yu. P.; Kurteev, E. N. pp 163-165 of Svoistva Rasplavlennykh Metallov. Gulyaev, B. B. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

A study was made of the effect of silicolanthanum, silicomischmetal, ferrocerium and yttrium on the cast properties of the steels Kh 18 N 9 L (18% Cr–9% Ni) and 40L. It is shown that modification of the steel with optimal additions of rare earths and yttrium increases the liquid mobility and decrease the cast shrinkage in comparison with the unmodified steel. (SJR)

3941 X RAY $N_{IV,V}$-EMISSION SPECTRUM OF THULIUM. Gribov, I. V.; Minin, V. I.; Finkel'shtein, L. D. (Inst. of Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 38: No. 1, 216-217 (Jul 1974). (In Russian).

The effect of the magnitude of the accelerating voltage on the form of the emission spectrum of thulium is investigated, and the "correct" form of the spectrum is obtained. The spectra were excited by electron bombardment at accelerating voltages of 0.3, 0.5, 1, 3 and 5 kV. Intensities of various maxima are plotted as a function of electron energies of various transitions for different accelerating voltages. The effect of self-absorption in thulium is practically absent below 1 kV accelerating voltage. Characteristic spectra of thulium at voltages of 3.0 and 0.3 kV corrected by subtraction of the bremsstrahlung spectrum and efficiency of the equipment are presented, and it can be seen that the effect of self-absorption substantially distorts the form of the spectrum at 3 kV. The spectrum of thulium taken at an accelerating voltage of 0.3 kV can be considered as correct. (SJR)

3942 PARAMETERS OF MUTUAL DIFFUSION BETWEEN NIOBIUM AND TANTALUM. Shinyaev, A. Ya.; Kopaleishvili, N. I. (Inst. of Metallurgy, Sverdlovsk, USSR). Fiz. Metal. Metalloved.; 38: No. 1, 222-224(Jul 1974). (In Russian).

The mutual diffusion of niobium and tantalum was investigated on single crystal samples in the form of disks 2 to 3 mm thick and 8 to 10 mm in diameter polished in a plane parallel direction. The single pairs were clamped together to obtain good contact. Annealing was carried out at 2000, 2100, 2300 and 2380°C with an annealing time of 20 to 40 minutes. The samples were cut and by x-ray microanalysis it was found that tantalum diffuses into niobium by a distance a factor of two greater than niobium diffuses into tantalum. Values of the activation energy Q (kcal/mole) and mutual diffusion coefficient D (cm^2/sec) are presented for mutual diffusion in the Nb–Ta system at 10, 20, 25, 35, 40, 45, 55, 60, 65, 70, 75, and 90 at.% Ta. Thus at 10 at.% Ta the value of Q is 82,000 kcal/mol and the value of D is 1.1×10^{-2} cm^2/s, while at 90 at.% Ta the value of Q is 99,000 kcal/mol and the value of D is 1.24×10^{-1}. (SJR)

3943 PHOTOELECTRON SPECTROSCOPIC INVESTIGATION OF THE ADSORPTION AND REACTIVITY OF OXYGEN ON PLATINUM. Norton, P. R. (Chalk River Nuclear Lab., Ont.). (1974). vp.

From international symposium on characterization of adsorbed species in catalytic reactions; Ottawa, Ontario (17 Jun 1974).

The interest in the adsorption and subsequent reduction of oxygen on platinum as a means of assessing platinum surface areas prompted the present investigation. The understanding of the current studies of the hydrogen-water exchange reaction, which is being considered as a possible method of heavy water production, could also be aided by a knowledge of the adsorption behavior of water on platinum. (auth)

3944 EMPIRICAL RELATIONSHIP FOR THE CRITICAL TEMPERATURE OF SOME A15 SUPERCONDUCTORS. Dew-Hughes, D. (Univ. of Lancaster, Eng.); Rivlin, V. G. Nature (London); 250: No. 5469, 723-724(30 Aug 1974).

An empirical relationship discovered by Hatt (J. Low Temp. Phys. 10: 285 (1973)) is discussed: this links the T_c of A15 superconductors (A_3B compounds) with the atomic mass, M_B, of the B element, log T_c being found to be a linear function of log M_B and high T_c values being predictable if M_B is small. The B element comprises Si, Ge or Sn (Group IVB) and the A element is V, Nb, or Ta (Group VA). It is stated that the discovery that Nb_3Ge has the highest known T_c (23.2K) provides an opportunity to test further the log T_c/log M_B relationship. Some deviations of the V compounds from the relationship are discussed, and it is stated that the relationship does not apply when the B element is a Group IIIB or transition metal. The existence of this empirical relationship raises three questions: first, what is its physical significance; secondly, why does it hold only for Group IV elements; thirdly, how far can it be used to predict high critical temperatures? These questions are discussed. (UK)

3945 FIELD DEPENDENCE OF THE ESR G-SHIFT IN SUPERCONDUCTORS. Baberschke, K.; Engel, U.; Huefner, S. (Freie Univ., Berlin). Solid State Commun.; 15: No. 6, 1101-1103 (15 Sep 1974).

Electron spin resonance (ESR) measurements at 36 GHz (Q-band) in Gd: $CeRu_2$ show a g-value in the superconducting phase different from previously published data measured at 9 GHz (X-band). This frequency dependent "g-shift" is attributed to the spatial change in local field in the vortex state for different external fields. (auth)

3946 EFFECT OF THERMAL STRESSES ON THE THERMAL EXPANSION AND CREEP OF COMPOSITE MATERIALS. Ivanov, V. E.; Zelenskii, V. F.; Krasnorutskii, V. S.; Ozhigov, L. S. Fiz. Khim. Obrab. Mater.; No. 4, 102-106(1974). (In Russian).

The effect of thermal stresses, arising in composite materials and Cu–W, Cu–Mo, and Mg–Be because of the differences in the coefficients of thermal expansion and elastic constants of the components, on the thermal expansion and creep of the composite materials was examined. It was established that the effective coefficients of thermal expansion of the composites and the temperature interval within which the thermal expansion remains elastic correspond with the calculated values. Under conditions of oscillation of the temperature, the creep rate of the composite material is significantly increased in comparison with results of isothermal tests. (tr-auth)

3947 TERNARY ALLOYS BASED ON Ni_3Fe ALLOYED WITH V. Sarkisyan, R. S.; Selisskii, Ya. P. (Central Scientific-Research Inst. of Ferrous Metals, Moscow). Fiz. Metal. Metalloved.; 37: No. 4, 832-836(Apr 1974). (In Russian).

The effect of vanadium on the ΔE effect, saturation magnetization, and mechanical properties of the ternary alloys Ni_3(Fe, V) was studied. The addition of V to Ni_3Fe in exchange for iron led to a sharp decrease in the saturation magnetization and in the ΔE effect. Annealing caused significant strengthening of the preliminarily hardened alloys, especially with a vanadium content greater than 5 at.%. An approximate phase diagram for Ni–Fe–V alloys was constructed for the nickel-rich region. (tr-auth)

3948 STRUCTURE OF TITANIUM-BASE ALLOYS AFTER COLD WORKING. Kadykova, G. N.; Gadzoeva, M. M. (Moscow Inst. of Electronic-Mechanical Engineering). Fiz. Metal. Metalloved.; 37: No. 4, 863-864(Apr 1974). (In Russian).

The results of dialtometric and x-ray studies showed that cold working of a titanium alloy with 35% Nb results in formation of a martensite phase with a tetragonal lattice, which is converted to a body-centered-cubic structure when heated to 250°C. A small amount of ω phase is also formed. The c axis of the tetragonal phase is oriented close to the direction of deformation. (MG)

3949 EFFECT OF TRACE IMPURITIES ON SUPERCONDUCTING TRANSITION TEMPERATURE IN Nb AND Nb_3Sn. Ronami, G. N.; Berezina, V. P. (Moscow State Univ.). Fiz. Metal. Metalloved.; 37: No. 4, 872-874(Apr 1974). (In Russian).

In niobium alloys and compounds $[(Nb_{1-x}\ Me_x)_3Sn]$ the presence of small amounts of impurities sharply decreased the superconducting transition temperature. For alloys with Ti, Zr, Hf, Cr, and Mo the minimum temperature was with 0.5 to 1.0 wt %, and for Nb_3Sn the minimum was with 0.4 wt%. The minimum could not always be precisely fixed because of the difficulty of making samples with the required small amounts of the alloying elements. (MG)

3950 TWO-BAND NATURE OF LEAD SOFTENING DURING SUPERCONDUCTING TRANSITION. Druinskii, E. I.; Fal'ko, I. I. (Kharkov State Univ.). Fiz. Metal. Metalloved.; 37: No. 4, 874-876(Apr 1974). (In Russian).

Experimental data on the temperature dependence of softening in lead were analyzed. The results, presented as graphs, agree with experimental data on electron heat capacity of lead. (MG)

3951 REGULARITIES OF CARBON DIFFUSION IN TRANSITION METALS WITH BODY-CENTERED-CUBIC LATTICE. Gruzin, P. L.; Makarov, N. M. (Central-Scientific Inst. for Ferrous Metals, Moscow). Fiz. Metal. Metalloved.; 37: No. 4, 895-896(Apr 1974). (In Russian).

The dependence of the activation energy of diffusion of carbon on the melting temperature of the transition metals and the radius of the pores of body-centered cubic lattice was studied. A straight-line dependence was shown. Since the pore of the lattice is proportional to the radius of the atoms of the lattice, the energy does not depend on the radius of the pores of the crystalline lattice but on the radius of the atoms in this lattice. With increase in the atom radius, the energy decreases. A formula is derived to show the dependence. (MG)

3952 DIFFUSION OF Zr AND Ni IN SINTERED ALUMINUM POWDER (SAP). Yakovlev, S. G.; Mozzhukhin, E. I.; Smirnov, P. B. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 145-148(1974). (In Russian).

Diffusion coefficients of Zr and Ni in sintered aluminum powder (SAP) and in massive aluminum were determined radiometrically by the use of ^{95}Zr and ^{63}Ni tracers in the temperature interval of 460 to 540°C. The diffusion rate of Zr in SAP is lower than in pure aluminum with diffusion coefficients of 2.2×10^{-3} and 8.5×10^{-5} cm^2/s respectively. The slowdown of Zr diffusion in SAP material in comparison with its diffusion in compact Al is apparently caused by chemical interaction of Zr with Al_2O_3 inclusions or with oxygen atoms incorporated in the aluminum metal matrix. (SJR)

3953 INCOLOY ALLOY 903 (AGE HARDENABLE LOW-EXPANSION ALLOY). Alloy Dig.; Fe–50: 2p(Jan 1974).

Incoloy alloy 903 is a precipitation hardenable Ni–Fe–Co alloy whose composition is 38.0% Ni, 15.0% Co, 0.7% Al, 1.4% Ti, 3.0% Nb, balance Fe. Its outstanding characteristics are high strength, a constant low coefficient of thermal expansion, and a constant modulus of elasticity. Stress-rupture properties of the alloy are governed by thermomechanical processing. Typical stress to produce rupture in 100 h on age-hardened material at 1200°F is 85,000 lb/in^2. Room-temperature, plane-strain fracture toughness of precipitation-hardened alloy is 100,600 $lb/in^2\ \sqrt{in.}$ Data are given on physical and mechanical properties, oxidation resistance (static at 1000 to 1200°F) and dynamic at 1200°F, heat treatment, workability, joining, corrosion resistance and applications. (Metals Abstr.)

3954 EFFECT OF ANNEALING ON THE STRUCTURE AND TENDENCY TO LAYERING OF LOW-ALLOY MOLYBDENUM ALLOY. Darmograi, V. V.; Mil'man, Yu. V.; Rachek, A. P.; Trefilov, V. I.; Khomenko, G. E. (Inst. of Metal Physics, Kiev). Metallofizika; No. 53, 32-38(1974). (In Russian).

A study was made of the effect of annealing in the temperature interval of 800 to 1300°C on the structure and mechanical properties of deformed molybdenum containing additions of carbon and zirconium. The structural studies were carried out by methods of transmission electron microscopy, optical metallography, and fractography of a layered surface. It is shown experimentally that layer separation of the deformed rolled material is caused by exposing a brittle crack along the boundaries of a layered, porous dislocation substructure which occurs during rolling. (SJR)

3955 EFFECT OF MICRO-ADDITIONS OF CERIUM ON SUBGRAIN DISORIENTATION IN PURE NICKEL. Koval, A. D.; Ol'shanetskii, V. E.; Stepanova, L. P. Metallofizika; No. 53, 72-75(1974). (In Russian).

Subgrain disorientation was determined in pure nickel and in nickel alloyed with micro amounts of cerium, (initial nickel purity of 99.9999%). For comparison consideration was also given to nickel alloys containing various alloying elements in significant amounts. It is shown that micro-alloying of nickel leads to an increase in the degree of disorientation of subgrain boundaries with the maximum angle of disorientation being observed in samples containing 0.5×10^{-3} atom fraction of cerium. (SJR)

3956 PHASE EQUILIBRIA IN TRANSITION METAL ALLOYS CONTAINING REFRACTORY CARBIDES. Shurin, A. K.; Dmitrieva, G. P. (Inst. of Metal Physics, Kiev). Metallofizika; No. 53, 91-97(1974). (In Russian).

On the basis of an analysis of known phase diagrams of ternary system (about 100 diagrams) which include two transition metals and carbon, a classification of these diagrams is proposed. A discussion is given of known data about the effect of a second metal on the solubility of carbon in the main metal. Regularities were established in the structure of eutectic quasibinary sections of ternary systems (Me-Me''C) with the composition and melting temperature of the eutectic alloys being presented as a function of the difference in melting temperature of the components. These eutectic alloys (especially those crystallized in an ordered manner) possess an increased heat strength, and can be additionally strengthened by aging. (SJR)

3957 ANNEALING CHARACTERISTICS AND LATTICE SITE LOCATION OF 40 keV Sn IMPLANTATIONS IN GaAs. Finstad, T. G.; Andersen, S. L.; Olsen, T. (Univ. of Oslo). Phys. Status Solidi (a); 25: No. 2, 515-521(16 Oct 1974).

Backscattering of ^{4}He-ions has been used to study the radiation damage as a function of annealing temperature in GaAs single crystals implanted with 40 keV Sn atoms at room temperature and 400°C. The doses varied between 10^{14} and 10^{15} ions/cm^2. The annealing characteristics for the room temperature implantations were similar to those reported for the recovery of the electrical conductivity in electron irradiated GaAs. The lattice site location of the implanted Sn atoms has also been investigated by the backscattering technique and for large doses 40 to 60% of the Sn atoms have been found to be substitutional. The lattice location does not seem to change in the temperature range 200 to 650°C. (auth)

3958 INFLUENCE OF SUBSTRUCTURE ON COERCIVITY OF $SmCo_5$ CRYSTALS. Deryagin, A.; Ulyanov, A. (Ural State Univ., Sverdlovsk, USSR). Phys. Status Solidi (a); 25: No. 2, K129-K131(16 Oct 1974).

The magnetic properties were measured using a vibromagnetometer with maximum magnetization of 28 kOe. Results show that the field value of reversal magnetization of single crystals is greatly influenced, besides known factors, also by the degree of sub-grain misorientation. The results of the studies on the influence of low-temperature annealing on the coercivity field value of $SmCo_5$ show that single crystal permanent magnets can be obtained for work at elevated temperatures. (JRD)

3959 STRESS–VELOCITY RELATIONS FOR DISLOCATIONS IN NIOBIUM. Walson, R. P.; Birnbaum, H. K. (Univ. of Illinois, Urbana). Phys. Status Solidi (a); 25: No. 2, 717-722(16 Oct 1974).

The stress-velocity relations for screw and for mixed dislocations in high purity niobium were studied at 298 and 196°K with attention particularly directed towards establishing asymmetry in the motion of dislocations. Etch pitting methods were used to reveal the dislocation positions after stress pulses in tension and compression. No asymmetry was observed for either screw or mixed dislocations moving on the $\{112\}$ or on the $\{110\}$. (auth)

3960 DIFFUSION COEFFICIENTS IN THE SYSTEM MOLYBDENUM–TUNGSTEN. Erley, W.; Wagner, H. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi (a); 25: No. 2, 463-471(16 Oct 1974).

The impurity diffusion coefficients of molybdenum in tungsten and tungsten in molybdenum were measured using single crystal samples. From the impurity diffusion coefficients and the self diffusion coefficients of the pure metals the tracer diffusion coefficients $D^*(c,T)$ of molybdenum and tungsten in Mo–W alloys are derived as function of temperature and alloy composition. The tracer diffusion coefficients show an exponential dependence on temperature and composition and are given by $D^*_{Mo}(c_{Mo},T) = 0.15 \exp(3.28\,c_{Mo}) \times \exp\{-(126500-11500\,c_{Mo})/RT\}$, $D^*_W(c_{Mo},T) = 1.88 \exp(0.75\,c_{Mo}) \exp\{-(140300-17100\,c_{Mo})/RT\}$. The thermodynamical factor α and the vacancy flow factor F were determined for the Mo–W system. Partial diffusion coefficients as obtained from the Kirkendall shift show good agreement with corresponding values obtained from the tracer diffusion coefficients. (auth)

3961 TEMPERATURE DEPENDENCE OF COERCIVITY FOR POWDERED INTERMETALLIC COMPOUNDS OF RCo_5 AND R_2Co_{17}. Ulyanov, A. I.; Deryagin, A. V. (Ural State Univ., Sverdlovsk, USSR). Phys. Status Solidi (a); 25: No. 2, 413-418 (16 Oct 1974).

Temperature dependence of coercivity for powdered intermetallic compounds of RCo_5 (R = Sm, Gd, Pr, Y) and R_2Co_{17} (R = Sm, Er, Tm) type was measured in the temperature range 77 to 300°K. The $H_c(T)$ dependence was compared with the temperature–dependent change of the main magnetic properties of the compounds. It is found to be determined mainly by the T-dependence of the mean magnetic constants K_1, K_2, and I_s. (auth)

3962 DISLOCATION SHEAR LOOPS IN ANISOTROPIC CRYSTALS. Scattergood, R. O.; Bacon, D. J. (Univ. of Liverpool). Phys. Status Solidi (a); 25: No. 2, 395-404(16 Oct 1974).

The shapes of closed dislocation shear loops were obtained by a self-stress method which takes into account both the crystal anisotropy and the dislocation self-interaction. Based on the results, a correlation between applied stress and loop size was established. This correlation requires one parameter to account for the anisotropy, which appears as an anisotropic shear modulus, and a second parameter to account for the self interaction. The latter is an appropriate logarithmic cutoff distance the order of the loop size, and is independent of the anisotropy. The shapes of the loops were compared to the de Wit-Koehler solutions, which ignore the interactions, and it is found that the shapes are similar in form, although the true shapes are somewhat more eccentric. The axial ratio of the true shapes approaches the de Wit-Koehler limit as the loop size becomes very large. It is shown that the loops can be matched closely by ellipses, except for certain special cases of anisotropy. (auth)

3963 ION IMPLANTATION IN METALS AND SUPERCONDUCTORS. Meyer, O.; Linker, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). KFK Nachr.; 6: No. 1, 1-9(1974). (In German).

8 figs.; 2 tabs.; 7 refs.

The physical foundations of ion implantation are briefly presented (range and range distribution, nuclear and electronic stopping, radiation damage, and sputtering). Results are given which were obtained by ion implantation in vanadium, nickel, and superconductors (radiation damage and healing behavior, lattice point occupation, distribution of the implanted ions and their diffusion behaviour by annealing the samples). The investigation was mainly carried out with the help of backscattering and channeling techniques using 2 MeV He^+ ions. (GE)

3964 ELECTROTRANSPORT OF OXYGEN AND NITROGEN IN NIOBIUM AND TANTALUM. Kirchheim, R.; Fromm, E. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Acta Met.; 22: No. 11, 1397-1403(Nov 1974).

Electrotransport of oxygen and nitrogen in niobium and tantalum was studied by a steady-state method. Oxygen and nitrogen migrate to the cathode. The sign of the effective charge Z^+ therefore is positive and its magnitude was determined from the concentration distribution, which was measured by micro-hardness testing. Investigations in the Ta–O system were expanded to a wide concentration and temperature range (0.2 to 1.0 at. % O and 1480 to 1870°K); it turns out that Z^+ of O in Ta is independent of concentration but decreases from +1.9 to +0.5 with increasing temperature. The effective charges of carbon, nitrogen, and oxygen in Va metals are summarized; a comparison with current theories shows that the experimental results can qualitatively be explained in terms of the electron drag model. (auth)

3965 DISPERSION-STRENGTHENED FERRITIC STEELS AS FAST-REACTOR STRUCTURAL MATERIALS. Huet, J. J.; Leroy, V. (CEN/SCK, Brussels). Nucl. Technol.; 24: No. 2, 216-224 (Nov 1974).

Dispersion-strengthened ferritic steels are being studied for possible use as canning material for sodium-cooled fast reactors. The basic alloy chosen contains nominally Fe–13% Cr–1.5% Mo–3.5% Ti to which 2% TiO_2 or 1% Y_2O_3 is added by a powder metallurgy technique. At 700°C, the alloys studied can favorably be compared in stress rupture tests (up to 12,000 h) to the best austenitic steels. Corrosion tests in dynamic sodium at 700°C showed that after 4000 h the effected zones remained narrow and had no significant influence on the mechanical resistance at high temperature. Neutron irradiation of these alloys demonstrated their remarkable resistance to embrittlement in mechanical tests at 700°C. Comparison with other alloys showed that they had the highest elongation to rupture after irradiation. Simulation tests by 1-MeV electrons gave almost zero swelling in the temperature range of 475 to 700°C. The combined properties of dispersion-strengthened ferritic alloys make them excellent candidates not only for canning material but also for shroud tubes for fast-reactor fuel elements. (auth)

3966 SUBSTITUTIONAL–INTERSTITIAL INTERACTIONS in Ta–Re–N AND Ta–Re–O ALLOYS. Sagues, A. A.; Gibala, R. (Case Western Resere Univ., Cleveland). Acta Met.; 22: No. 11, 1423-1432(Nov 1974).

Anelastic techniques have been employed to determine the extent of substitutional–interstitial interactions in Ta–Re–N and Ta–Re–O alloys. Analyses of the concentration and temperature dependence of Snoek-type anelasticity in these alloys has disclosed that unassociated N atoms and N atoms in ReN and Re_2N clusters relax in Ta–Re–N alloys. The binding enthalpies of the Re–N clusters are $\Delta H_b^{(ReN)} = 3200 \pm 600$ cal/mole and $\Delta H_b^{(Re_2N)} = 4700 \pm 2000$ cal/mole. There appear to be only small changes in the specific (unit) relaxation strength of N in Ta when it clusters with one or two Re atoms. A wide spectrum of Re_mO clusters, where m = 0 to 3, exhibit relaxation in Ta–Re–O alloys. The binding enthalpies of Re–O clusters are probably larger than for Re–N clusters, but the complex nature of the anelastic spectra precludes a quantitative determination. (auth)

3967 ANISOTROPY OF MAGNETIC PROPERTIES IN 79 NM ALLOY PLATE HAVING A CUBIC TEXTURE. Glotova, L. S.; Gertman, Yu. M. Fiz. Metal. Metalloved.; 38: No. 1, 202-204 (Jul 1974). (In Russian).

The study was made on an alloy plate 0.1 mm thick having a cubic texture with the following composition: 79.8% Ni, 3.99% Mo, 0.93% Mn, 0.38% Si, and remainder Fe. After measurement of the magnetic properties the samples were subjected to thermal treatment. It was found that the metal plate has a minimum value of magnetostriction during magnetization in the direction of rolling, and a maximum value in the transverse direction. After thermal treatment there is only a slight change in the anisotropy of magnetic properties. (SJR)

3968 VALENCE OF YTTERBIUM IN SOME CUBIC COMPOUNDS. Percheron-Guegan, A. (CNRS, Meudon, France); Achard, J. C.; Gorochov, O.; Gonzalez-Jimenez, F.; Imbert, P. J. Less-Common Metals; 37: 1-8(1974). (In French).

Electrical resistivities, magnetic susceptibilities and isomer shifts of the Mössbauer spectra of some cubic intermetallic compounds with diamagnetic alloyed elements, i.e. $YbIn_3$, $YbPb_3$ and $YbAl_2$, have been investigated and compared. The magnetic behavior of these compounds has been investigated over the temperature range 10 to 300°K. The values of the susceptibility at room temperature are very small and $YbSn_3$, in particular, is diamagnetic. Electrical resistivities have been measured between 4 and 300°K. The values at room temperature are in the vicinity of that of pure ytterbium. The isomer shifts of the resonance line of ^{170}Yb relative to ytterbium metal at 4.2°K are very near to the values for $YbIn_3$, $YbSn_3$ and $YbPb_3$ but more negative than the value for $YbAl_2$. (auth)

Radiation Effects

Refer also to abstract 5245.

3969 (BNL-19243) RECENT STUDIES OF POINT DEFECTS IN METALS: SELECTED TOPICS. Goland, A. N. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 154p. Dep. NTIS $10.75.

The lectures cover statistical thermodynamics of point defects in equilibrium content, determination of point defect parameters and configurations, elastic property changes, and radiation damage. (53 fig, 83 references) (DLC)

3970 (HEDL-SA-656(Rev.1)) SWELLING IN ELECTRON-IRRADIATED 316 STAINLESS STEEL. Laidler, J. J.; Mastel, B.; Garner, F. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1974. Contract AT(45-1)-2170. 24p. (CONF-740651-4). Dep. NTIS $4.25.

From symposium on the effects of radiation on structural materials; Gatlinburg, Tennessee, USA (11 Jun 1974).

The material to be used for fuel cladding and ducts in the Fast Test Reactor (FTR) is 20% cold worked AISI Type 316 stainless steel. The material is required to operate at temperatures as great as 750°C, with a goal peak fluence of the order 1.2×10^{23} n/cm² (E > 0.1 MeV). Current core design is based on extrapolative equations fit to low-fluence neutron irradiation swelling data for solution-treated and cold worked Type 316 stainless steel, most of which was not prototypic material, with the data extending to fluences of $5-7 \times 10^{22}$ n/cm² (E > 0.1 MeV). The same alloy is the design material for the LMFBR Demonstration reactor. The data base remains the same, but the operating temperatures are slightly different, due to somewhat lower coolant outlet temperature. In order to obtain some indication of the validity of the extrapolations prior to the availability of high-fluence neutron irradiation data, simulation methods are being employed. One technique in use at present involves the irradiation of cladding specimens with 1 MeV electrons in a high voltage electron microscope (HVEM). The first HVEM simulation experiments were conducted on material which was prototypic in composition only. The second set of irradiations were on fully prototypic fuel cladding material. Results are reported which have led to a number of important conclusions regarding the expected behavior of FTR and DEMO-I fuel cladding and ducts. (auth)

3971 POINT DEFECT CLUSTERS IN NEUTRON-IRRADIATED MOLYBDENUM. II. Interpretation of the Experimental Results in Terms of Chemical Rate Equations. Niebel, K. (Univ., Stuttgart); Wilkens, M. Phys. Status Solidi (a); 25: No. 1, 77-84 (16 Sep 1974).

The dose dependence of the number density, n_l, and the mean diameter, $\bar{d}$, of the dislocation loops of interstitial type as observed in neutron-irradiated molybdenum of nominal purity 99.95% is interpreted in terms of the chemical rate equations of Brown, Kelly, and Mayer. The analysis yields a value of the effective displacement cross section for fast neutrons which compares well with other data in the literature, and an estimate of the binding energy of interstitials to impurity atoms. (auth)

3972 INITIAL RATE OF ACCUMULATION OF FRENKEL DEFECTS IN PLATINUM. Lwin, Y. N.; Brown, P. A.; Jackson, J. J.; Ryan, E. A. (Argonne National Lab., IL). Phys. Status Solidi (a); 25: No. 1, 223-230(16 Sep 1974).

The resistivity increase in platinum irradiated in many increments with light ions to small total doses is investigated as a function of irradiation temperature and of pre-irradiation vacancy concentration. The results differ greatly from those found in similar investigations with near threshold electron irradiations. Different, more complex defect structures are produced in the present work. Much caution must be used in extrapolating the results of electron irradiations to ion or neutron irradiations. (auth)

3973 STUDY OF DISLOCATION PINNING IN COLD-WORKED COPPER BY MODULUS MEASUREMENTS. Bischoff, A. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi (a); 25: No. 1, 153-164(16 Sep 1974). (In German).

The influence of neutron irradiation, quenching, and impurities on the dislocation pinning behavior in subsequently plastically deformed Cu was investigated by measuring the recovery of the elastic modulus. This procedure allows conclusion to be drawn about the nature of point defects annealing in distinct temperature ranges. Based on the isothermal recovery of the elastic modulus, the measured activation energy, and by comparison of the computed modulus curve with that observed experimentally, it is concluded that in the range of stage III the recovery kinetics are determined by the mechanical aftereffect of dumbbell-interstitials. (auth)

3974 EFFECTS OF NEUTRON IRRADIATION ON THE CRITICAL CURRENT DENSITIES OF (Nb-1 at.% $U)_3Sn$ MULTIFILAMENTARY COMPOSITES. Luhman, T. S.; Suenaga, M. (Brookhaven National Lab., Upton, N. Y. (USA)). Phys. Lett., A; 49: No. 2, 113-114(26 Aug 1974).

Multifilamentary composite wires of (Nb-1 at.% $U)_3Sn$ made by a solid state diffusion process were irradiated at 60 ± 5°C with slow thermal neutrons and a fluence of 1×10^{16} nvt. Radiation induced increases in J_c previously observed in tin-dipped (Nb-1 at.%$U)_3Sn$ are not observed in bronze reacted (Nb-1 at.%$U)_3$ Sn. (auth)

3975 DETERMINATION OF THE DEPTH DISTRIBUTION OF IMPLANTED HELIUM ATOMS IN NIOBIUM BY RUTHERFORD BACKSCATTERING. Roth, J.; Behrisch, R.; Scherzer, B.M.U. (Max–Planck–Institut für Plasmaphysik, EURATOM Association, D–8046 Garching b, München, Germany). Appl. Phys. Lett. 25: No. 11, 643-644 (1 Dec 1974).

Using Bragg's rule of additivity of the stopping powers in compounds and the Rutherford backscattering technique to determine electronic stopping powers, the depth distribution of 4–keV helium ions implanted in niobium was determined for different implantation temperatures. (auth)

3976 THERMAL AND IRRADIATION EFFECTS ON THE TENSILE AND CREEP-RUPTURE PROPERTIES OF WELD-DEPOSITED TYPE 316 STAINLESS STEEL. Ward, A. L. (Hanford Engineering Development Labs., Richland, WA). Contract AT(45-1)-2170. Nucl. Technol.; 24: No. 2, 201-215(Nov 1974).

An experimental characterization of the effects of thermal treatments and of fast-neutron irradiation on the elevated-temperature tensile and creep-rupture properties of a gas tungsten-arc-deposited Type 316 stainless steel has been completed. Intermediate-temperature (1472°F) stress relief and high-temperature (1950°F) solution annealing produce changes in the mechanical properties, some of which may be correlated with coincident changes in the microstructure. Irradiation-induced property changes observed in the weld metal are broadly consistent with trends established for wrought Type 316; however, the extent of property change clearly depends on the condition (heat treatment) of the material as well as fluence, irradiation temperature, and test temperature. (auth)

Other Materials

Refer also to abstracts 2945, 3451, 3472, 5191, and 5201.

3977 (AD-779872) ZERO-FIELD PARAMAGNETIC RESONANCE OF TRIVALENT GADOLINIUM IN SEVERAL LANTHANUM TRIS (ETHYLSULFATE) NONAHYDRATES AND NONADEUTERATES: DETERMINATION OF CRYSTAL FIELD AND HYPERFINE STRUCTURE PARAMETERS. Technical Report, 1 June–30 November 1974. Bernstein, E. R.; Dobbs, G. M. (Princeton Univ., N. J. (USA)). 1 Jun 1974. 82p. NTIS $4.00.

Employing isotopically pure trivalent ^{155}Gd, ^{157}Gd, and ^{160}Gd as guests in dilute mixed crystals of lanthanum tris (ethylsulfate) nonahydrate ($La_3(C_2H_5SO_4)3.9H_2O$), it has been possible to determine both accurate zero-field splitting parameters of crystal field origin and hyperfine structure constants due to magnetic dipole and electric quadrupole interaction terms. The zero-field paramagnetic resonance spectroscopic method is used. It is reasoned that the quadrupole hyperfine constant is due, almost entirely, to lattice contributions; moreover, it is shown to be of the expected order of magnitude and sign. The hyperfine anomaly is discussed. A set of crystal field parameters are reported for the first time for ^{160}Gd in crystals of La ($C_2H_5SC_4$) 3.9D_2O which differ significantly from those of the hydrate. Variations of crystal field parameters with various lanthanon host ions are also observed. Comments concerning zero-field line widths and their measurements are included. (GRA)

3978 (AD-780613) PROPERTIES OF ENERGETIC IONS TRAPPED IN SOLIDS OF INTEREST AS FUTURE ENERGY SOURCES. Final Report, 1 October 1969–30 September 1973. Kevan, L. (Wayne State Univ., Detroit, Mich. (USA). Dept. of Chemistry). Dec 1973. 31p. (AFOSR-TR-74-0800). NTIS $3.25.

A final report is given of research designed to extend the knowledge of production, storage and utilization of highly energetic chemical species. The research concentrated on the physical and chemical properties of radiation-produced ions trapped in solid matrices. The first definitive and comprehensive picture of trapped electron energy levels in glassy matrices extending over a broad range of polarity was obtained from both experimental and theoretical studies. Mobility measurements of electrons in conduction states of glassy matrices have allowed the identification of the dominant electron scattering mechanisms. New methods involving electron–electron double resonance were developed to study magnetic energy transfer between ions and radicals in disordered solids. The spatial correlation between cations and electrons produced by photoionization was shown to depend upon the photoionization energy. These studies lay the groundwork for characterizing the stability of ion trapping in disordered solids. Included are abstracts of 34 papers completed on this project. (GRA)

3979 (AD-781165) SOLID-STATE MATERIALS AND DEVICES. Final Report, 1 September 1972-31 August 1973. Lindholm, F. A.; Brodersen, A. J.; Chenette, E. R.; Li, S. S. (Florida Univ., Gainesville (USA)). 1 Dec 1973. 141p. (AFCRL-TR-74-0044). NTIS $4.75.

Contents are transistor circuit models; questionability of drift-diffusion transport in the analysis of small semiconductor devices; the effect of neutron radiation on noise in field-effect transistors; a new high sensitivity integrated silicon Schottky-barrier phototransistor; analyses of transient capacitance experiments for Au-GaAs Schottky barrier diodes in the presence of deep impurities and the interfacial layer; and an evaluation of carrier domain devices for functional integrated circuits. (GRA)

3980 (AED-CONF-74-081-006) CARBON FIBERS AS REINFORCING COMPONENT IN METALLIC AND NON-METALLIC COMPOSITE MATERIALS. Fitzer, E. (Karlsruhe Univ. (TH) (F.R. Germany). Inst. fuer Chemische Technik). 1974. 43p. (In German). INIS.

From meeting: composite materials; Konstanz, F.R. Germany (28 Mar 1974).

30 figs.; 5 tabs.; 27 refs. With abstract.

On the basis of some studies, a report is given on the possible uses of carbon fibers as reinforcement in high temperature materials. The use of composite bodies at higher temperatures gives rise to additional problems due to the different thermal expansion and chemical compatibility of the components as well as to problems in the preparation of the composite body. It is shown that high temperature polymers such as polyimides, as well as polycrystalline carbon represent ideal matrix materials for carbon fiber reinforced composite bodies. With unidirectional reinforcement one obtains composite material properties of about 100 kp/mm^2. In the case of carbon as matrix, these mechanical properties are maintained up to the highest temperatures. When using carbon fibers in an oxide or metallic matrix, protective layers must be coated on the fibers which prevent the reaction and diffusion between reinforcing element and matrix and enable wetting. The coating of the carbon fibers by means of chemical gas phase separation is reported and it is shown that the mechanical properties of the carbon fibers are not influenced by metal or carbide layers. The apparatus developed at the institute for coating is closely gone into. Coated carbon fibers as reinforcing elements in glasses and quartz glass permit composite materials with new properties to be expected. With this type of fibers, reinforced aluminium enables applications in the 400°C region. It is shown that carbide interlinings even enable a reinforcement of iron metals by carbon fibers which is also still effective in the temperature region of 900°C. (GE)

3981 (AED-CONF-74-327-001) SUBHALIDES OF TELLURIUM: A NEW GROUP OF COMPOUNDS WITH "MODIFIED" TELLURIUM STRUCTURES. Alpen, U. V.; Kniep, R. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart (F.R. Germany)). 1974. 5p. INIS.

From 12th international conference on the physics of semiconductors; Stuttgart, F.R. Germany (15 Jul 1974).

5 figs.; 8 refs. With abstract.

A new group of semiconductors is presented whose crystal structures are closely related to that of elemental tellurium. The electrical conductivities of these compounds are correlated to their crystal structures. The Raman-spectrum and the optical properties of α–TeI in the band gap, and the Restrahlen-region are presented. (auth)

3982 (CEA-R-4579) TRANSFER OF NOBLE GASES THROUGH LIQUID SODIUM. Experiments with the ATENA Loop. Saroul, J.; Michel, R. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. de Surete Nucleaire). Sep 1974. 45p. (In French). Dep. NTIS (US Sales Only) $5.25.

In a sodium loop containing about 200 liters of sodium an attempt was made to demonstrate the delay that sodium in motion brings to the transfer of noble gases to the argon blanket, for varying gas and sodium flow-rates. After a brief description of the loop and its equipment, the various experiments performed are detailed including gas bursts and emission of gases at small flow-rates. Results of the experiment showed in all cases that the noble gases transfer toward the argon was total, within the measurement accuracy, but that the kinetics of their release by sodium depended on both sodium and gas flow-rates. In particular, the gases emitted at a small flow-rate are shown to be released by the sodium according to exponential laws, the period of which increases as the gas flow-rate decreases or as the sodium flow-rate increases. Gas recycling within the loop is also shown to be possible. (auth)

3983 (CEA-R-4607) ORIGINAL METHOD AND APPARATUS TO STUDY THE INTERACTION OF WATER VAPOR ON MATERIALS. (Application to the Evaluation of Hydrogen Products Fixed and Desorbed from Graphite at Different Temperatures). Chenion, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). Oct 1974. 81p. (In French). Dep. NTIS (US Sales Only) $7.25.

Thesis. Presented to Paris Univ. (France).

An apparatus designed for studies on the interaction of water vapor with a wide range of materials is described. The water vapor is carried by helium at atmospheric pressure. The extreme sensitivity of the method is due to the use of tritium, radioactive tracer of hydrogen. The apparatus used and both its scope and its limits are described. The results are greatly superior to those obtained with conventional methods (volumetry, thermogravimetry) and it offers great versatility of application, the specific activity of the tritiated water used as adsorbate being adaptable to the phenomenon investigated. The contribution of the apparatus itself in water vapor adsorption and desorption phenomena is examined. Finally the method and apparatus are applied to a short study of the action of water vapor on nuclear graphite. The quantities of hydrogen in the degassed products are evaluated and compared with the amount of water which has reacted with the graphite. (auth)

3984 (CONF-741002-P1, pp 403-410) SPECTRAL PARAMETERS OF APROTIC Pr^{3+} AND Nd^{3+}. Tandon, S. P. (Univ., Dortmund, W. Ger.); Surana, S. S. L.; Mathur, R. C. 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

The absorption spectra of rare earth ions in aprotic solvents are analyzed. $SeOCl_2$ + $SnCl_4$ solutions containing Pr^{+3} or Nd^{+3} ions were prepared and the spectra of these solutions recorded. Discussions and information are included on electronic energy levels, spectral intensities, and interaction and intensity parameters. (JRD)

3985 (MLM-2161(OP)) RADIATION DAMAGE IN LiT. Bowman, R. C. Jr.; Attalla, A. (Mound Lab., Miamisburg, Ohio (USA)). 1974. Contract AT(33-1)-Gen-53. 13p. (CONF-740348-1). Dep. NTIS $4.00.

From meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (25 Mar 1974).

Pulsed NMR was used to characterize the lithium metal, molecular tritium, and ^3He produced in LiT from the decay of tritons. The concentrations, spin–lattice relaxation times, and spin–spin relaxation times of these species were measured. Effects of both temperature and irradiation dose were investigated. The radiation damage in LiT is compared with that observed in gamma-irradiated LiH. The mechanisms responsible for radiation damage in these systems are briefly discussed. (auth)

3986 (TT-73-58001) RARE-EARTH THORIUM FLUORITE. Nozkin, A. D. Translated from Zap. Vses. Mineral. Obshchest.; 100: No. 3, 334-337([nd]). 6p. NTIS $4.00.

The rare earth thorium fluorite discovered in one of the rare earth regions of Siberia is discussed. (GRA)

3987 (UCRL–51644) HIGH TEMPERATURE CARBON EQUATION OF STATE. Gathers, G. R.; Shaner, J. W.; Young, D. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Sep 1974. Contract W-7405-eng-48. 15p. Dep. NTIS $4.00.

The isobaric expansion technique is used to determine the equation of state of carbon at high temperatures and kilobar pressures. Glassy carbon samples are resistively heated to the melt and liquid regions, and the data are plotted in the enthalpy-volume and resistivity-enthalpy planes. The data are also approximately fitted with a GRAY three-phase equation-of-state model suitable for use in hydrodynamics codes. (16 fig, 2 tables) (auth)

3988 GAMMA-MAGNETIC AND GAMMA-ACOUSTIC RESONANCES IN PARAMAGNETS. Mitin, A. V.; Chugunova, G. P. (AN SSSR, Kazan. Fiziko-Tekhnicheskij Inst.). Phys. Lett., A; 49: No. 2, 111-112(26 Aug 1974).

Gamma-magnetic and gamma-acoustic resonances in paramagnets are considered. It is shown that the hyperfine amplification of the radiofrequency or ultrasonic fields at the nucleus is the condition for the observation of these effects. (auth)

3989 NEUTRON-DIFFRACTION INVESTIGATION OF UPSe AND UAsS. Zygmunt, A. (Inst. for Low-Temperature and Structure Research, Wroclaw); Ligenza, S.; Ptasiewicz, H.; Leciejewicz, J. Phys. Status Solidi (a); 25: No. 1, K77-K80(16 Sep 1974).

Results are reported on neutron diffraction determination of the magnetic moment of UPSe and UAsS at 4°K. The crystal structures of these compounds were also studied and their parameters established. (JRD)

3990 TRANSPORT OF EXCESS CHARGE IN ELECTRON–IRRADIATED DIELECTRICS. Gross, B.; de Oliveira, L.N. (Instituto de Física e Química de São Carlos, Universidade de São Paulo, 13560 São Carlos, São Paulo, Brazil). J. Appl. Phys. 45: No. 11, 4724-4729 (Nov 1974).

Irradiation of dielectrics with nonpenetrating electron beams has been used for practical purposes, e.g., manufacturing of electrets, and as a research tool, e.g., the investigation of induced conductivity and transport properties. Aspects of the theory of charge transport and storage and radiation–induced conductivity in irradiated dielectrics are discussed. It is assumed that the dielectric is kept in short circuit and that the range of the incident electron beam is smaller than half the sample thickness. The treatment applies only to dielectrics which have a very low dark conductivity and contain a great number of deep traps. (auth)

3991 INVESTIGATION OF THE CRYSTAL FIELD IN RARE–EARTH DOPED SCHEELITES. Vishwamittar; Puri, S.P. (Department of Physics, Punjab Agricultural University, Ludhiana–141004, India). J. Chem. Phys. 61: No. 9, 3720-3727 (1 Nov 1974).

The crystalline fields in rare–earth doped scheelites are examined, and it is shown that the angular overlap model is inadequate to account for the results. The analysis of Yb^{3+} crystal field parameters under the assumption of the superposition model leads to surprisingly small exponents and large second– and fourth–order intrinsic parameters, which have been determined quite accurately. The difference of the findings from those in the other O^{2-} ligated systems is attributed to the strong binding in $XO_4{}^{2-}$ complexes. The intrinsic parameters for an actinide (Np^{4+}) are reported for the first time, and their large magnitude is ascribed to the large spatial expansion of the 5f orbitals. The transformation of the coordinate systems to eliminate one or both of the imaginary crystal field parameters is discussed in the framework of the superposition model. Also included is the analysis of the zero–field splitting of Gd^{3+} in these crystals. (auth)

3992 TITANIUM IMPURITY CENTER INDUCED IN IRRADIATED SILICATE GLASSES. Arafa, S.; Assabghy, F. (Solid State and Materials Research Center, The American University in Cairo, Egypt). J. Appl. Phys. 45: No. 12, 5269-5271 (Dec 1974).

The induced ESR spectra in silicate glasses is examined with particular emphasis on the reported ESR line centered at $g \sim 1.96$. This resonance is shown to arise from an induced center associated with titanium which is present in the glass as a trace impurity. The optical absorption band corresponding to this center was observed, at 2.4 eV, in the Gaussian resolution of the induced optical absorption spectrum. It is argued that the interpretation of induced ESR and optical absorption spectra in silicate glasses should take into account this induced titanium center in all glasses whose purity has not been the object of considerable attention. (auth)

3993 CELLULAR PLASTICS FOR CRYOGENIC INSULATION. Hayes, R. G. (Upjohn Co., Torrance, CA). Cryog. Technol.; 8: No. 4, 127-128; 137(1972).

The Brunei Project under construction on the island of Borneo to provide Osaka and Tokyo with clean-burning natural gas is described. Natural gas from the offshore well will be fed to the new processing plant near Lumut, liquified, loaded into ocean-going tankers, and transported across the China Sea to Japan. The closed-loop system through which LNG circulates at a constant operating temperature of –258°F is insulated with about 6 inches of urethane foam and the gas handling lines have two inches of foam. The ship loading piping system is described. Insulation specifications and all forms of insulation considered for the project are examined. When the Brunei project is completed it will have consumed 250,000 pounds of urethane foam, Isonate CPR 285-2.5, a fire-retardant, fluorocarbon-blown rigid urethane spray system formulated by CPR Div., The Upjohn Co. (MCW)

3994 TERNARY SYSTEMS OF LITHIUM CHLORIDE, SODIUM CHLORIDE, URANIUM TRICHLORIDE, AND URANIUM TETRAFLUORIDE. Desyatnik, V. N.; Raspopin, S. P.; Trifonov, I. I.; Tsybizov, A. M. Sov. At. Energy (Engl. Transl.); 35: No. 5, 1028(Nov 1973).

Translated from At. Energ. (USSR); 35: No. 5, 345(Nov 1973). This is a summary of paper No. 700/7276 with full copy held at TIC.

A study was undertaken of $LiCl-UCl_3-UF_4$ and $NaCl-UCl_3-UF_4$ systems by the differential thermal analysis method, backed up to a partial extent by x-ray analysis. It was found that melts of the system $LiCl-UCl_3-UF_4$ form two eutectic points and two peritectic points upon crystallization. One eutectic is characterized by the melting point 350 ± 2°C and corresponds to the composition LiCl 43 mole %, UCl_3 25 mole %, and UF_4 32 mole %. Another eutectic corresponds to the composition LiCl 13 mole %, UCl_3 34 mole %, and UF_4 53 mole % and melts at 455 ± 2°C. The melt at one peritectic point crystallizes at 465 ± 2°C and corresponds to the composition LiCl 14 mole %, UCl_3 36 mole %, and UF_4 50 mole %. At another peritectic point a melt of the composition LiCl 25 mole %, UCl_3 5 mole %, and UF_4 70 mole % crystallizes at 600 ± 2°C. A determination was made of the quasibinary section $UCl_3-LiCl \cdot 2UF_4$ which divides the ternary system $LiCl-UCl_3-UF_4$ into two secondary subsystems. The primary crystallization surface of the ternary system $NaCl-UCl_3-UF_4$ is represented by seven fields. The quasibinary section $UCl_3-3NaCl \cdot 2UF_4$ divides the system into two secondary subsystems. Two eutectic points, two peritectic points, and a single "transitory" point were determined in the system. One eutectic point crystallizes at 415 ± 2°C and corresponds to the system NaCl 34 mole %, UCl_3 21.5 mole %, and UF_4 44.5 mole %. Another eutectic crystallizes at 430 ± 2°C, corresponding to the composition NaCl 55 mole %, UCl_3 22.5 mole %, and UF_4 22.5 mole %. The melts at the "transitory" point are of composition NaCl 16 mole %, UCl 34 mole %, and UF_4 50 mole % and crystallize at 530 ± 2°C. (auth)

3995 HIGH-TEMPERATURE IRRADIATION OF STRUCTURAL GRAPHITE. Kalyagina, I. P.; Virgil'ev, Yu. S.; Zolotukhin, V. R.; Klimenkov, V. I.; Shevyakov, V. P.; Shurshakova, T. N. Sov. At. Energy (Engl. Transl.); 36: No. 3, 263-265(Mar 1974).

Translated from At. Energ. (USSR); 36: No. 3, 212-215(Mar 1974).

Radiation effects on graphite materials differing in their properties were investigated. It was found that the rate of radiation-induced shrinkage experienced by the specimens attains a maximum at 450°C and slackens off as the irradiation temperature rises to 700 to 950°C. A rise in the graphitization temperature of grade GMZ graphitic material to 2800 to 3000°C lowers the shrinkage rate of the material to about half. Sealing impregnations with anthracitic pitch exert virtually no effect on dimensional changes. Highest stability is exhibited by isotropic uncalcined coke materials. At neutron doses below 10^{22} neutrons/cm^2 and at temperatures in the range 450 to 800°C, secondary swelling makes its appearance. (auth)

3996 TEMPERATURE DEPENDENCE OF CONDUCTIVITY OF TETRATHIAFULVALENE-TETRACYANOQUINODIMETHANE (TTF-TCNQ) SINGLE CRYSTALS. Groff, R. P.; Suna, A.; Merrifield, R. E. (du Pont de Nemours (E. I.) and Co., Wilmington, DE). Phys. Rev. Lett.; 33: No. 6, 418-421(5 Aug 1974).

The conductivity of single crystals of tetrathiafulvalene–tetracyanoquinodimethane (TTF-TCNQ) was measured over the temperature range 40 to 300°K. The maximum low-temperature conductivity parallel to the b axis was higher than the corresponding room-temperature value. The temperature dependence of the intrinsic conductivity (after residual resistivities were excluded) was the same for all crystals measured and was fitted by a $T^{-2.33\pm0.14}$ dependence for $60 \leq T \leq 300$°K. (auth)

3997 IMPROVED BAND STRUCTURE OF V_3Si. Weger, M.; Barak, G. (Hebrew Univ., Jerusalem). Phys. Lett.; 48A: No. 5, 319-320(15 Jul 1974).

An improved band structure for V_3Si is proposed, based on recent calculations and experiments. It agrees with all the experiments relating to the band structure carried out so far. (auth)

3998 RADIATSIONNYE EFFEKTY V KREMNII. (Radiation Effects in Silicon). Konozenko, I. D.; Semenyuk, A. K.; Khivrich, V. I. Kiev; Izdatel'stvo Naukova Dumka (1974). 200p.

Studies on radiation effects in silicon carried out in 1973 are systemized and generalized. Basic concepts are presented on the creation of defects in crystals and a number of the more efficient methods of investigating these defects are described. An analysis is carried out of models of identified radiation defects and their effect on the physical properties of silicon single crystals. Results of investigating volume gradient phenomena and kinetic effects in crystals of silicon and germanium irradiated with ^{60}Co gamma rays, fast electrons and neutrons are included. (SJR)

3999 DIELECTRIC LOSS OF LiD DOPED WITH Mg^{2+}. Varotsos, P. (Univ. of Athens); Katsaros, W. Phys. Status Solidi (a); 25: No. 2, 457-461(16 Oct 1974).

The dielectric relaxation of LiD containing Mg^{2+} impurity has been investigated by the dielectric loss method. Two peaks have been observed at the dielectric loss curve which are attributed to the pairs of the substitutional impurity with the first neighbor vacancy and with the second neighbor vacancy. The plots of ln f_m (f_m being the peak frequency) vs. 1/T are found to be straight lines for both the peaks and yield 0.43 and 0.71 eV as the values for activation energies for the high and the low frequency peaks, respectively. The experimental results are not consistent with Dreyfus' model. (auth)

4000 INVESTIGATIONS OF ANISOTROPY AND ANOMALY OF THE ELECTRON SPIN RELAXATION TIME IN FERROELECTRIC CRYSTALS BY MEANS OF THE ELECTRON SPIN ECHO METHOD. Voelkel, G.; Bartuch, U.; Brunner, W.; Windsch, W. (Karl-Marx-Univ., Leipzig). Phys. Status Solidi (a); 25: No. 2, 591-597(16 Oct 1974).

X-irradiated ferroelectric single crystals of hydrogen bonded Rochelle salt, dicalcium strontium propionate, and triglycine sulfate (TGS) were studied by means of the electron spin echo method. The investigated spin–lattice relaxation time T_1 shows characteristic anomalies at temperatures immediately below the Curie point. The study of the angular dependence of T_1 in Rochelle salt gives the result, that the relaxation rate is not caused by rotational vibrations of the molecule, but by phonon modulation of the spin–orbit coupling. (auth)

4001 MECHANISM OF SENSITIVITY REDUCTION IN SELENIUM LAYERS IRRADIATED BY X RAYS. Kalade, J.; Montrimas, E.; Rakauskas, J. (Vilnyus State Univ., USSR). Phys. Status Solidi (a); 25: No. 2, 629-636(16 Oct 1974).

The process of sensitivity reduction (fatigue) in amorphous selenium layers irradiated by x-rays has been considered taking into account carrier photogeneration, trapping, and recombination. Analytical expressions describing the kinetics of carrier trapping at the levels responsible for a fatigue have been obtained. Formulas to determine a sensitivity of both fatigued and unfatigued layers have been derived. Computed and experimental dependences of sensitivity upon the layer thickness and the hardness of x-rays are in a good qualitative agreement. Theoretical dependences of fatigue vs. irradiation dose, layer thickness, electric field, and density of traps correctly reflect analogous experimental regularities. It has been established that the fatigue dependence on the irradiation dose rate is determined by the carrier lifetime at the traps responsible for a fatigue process. Comparing theoretical results with experimental data on fatigue, the density of traps responsible for a fatigue process have been determined as well as values of recombination and trapping coefficients in electroradiographic selenium layers. (auth)

4002 THERMOLUMINESCENCE OF THIOUREA EXCITED BY X RAYS. Rucci, A.; Serpi, A.; Serpi Macciotta, P. (Cagliari Univ., Italy). Phys. Status Solidi (a); 25: No. 2, L191-K194(16 Oct 1974).

The thermoluminescent properties of thiourea were studied to gain information on lattice defects and radiation damage in this compound. It was found that no light emission was observed if instead of x rays, uv radiation was used for excitation of the samples. This fact confirms that breaking hydrogen bonds can account for the thermoluminescence process. (JRD)

4003 THE BEHAVIOUR OF LOW-PRESSURE POLYETHYLENE EXPOSED TO IONIZING RADIATION. Wilski, H. (Farbwerke Hoechst A. G., Frankfurt am Main (F. R. Germany)). Kolloid-Z. Z. Polym.; 251: No. 9, 703-709(Sep 1973). (In German). 9 figs.; 4 tabs.; 11 refs.

Low-pressure polyethylene, which is crosslinked by irradiation by exclusion of oxygen, is degraded by irradiation in the presence of oxygen. The dose which is necessary to reduce the ultimate elongation of the material under investigation to 50% of its initial value is 265 kJ/kg by absence of oxygen (short-time irradiation). When oxygen is present during irradiation, the dose lies between 4 and 14 kJ/kg only (long-time irradiation). It is shown that the reduction of the ultimate tensile strength and the ultimate elongation are consequences of the radiation-induced reduction of the molecular weight. (auth)

4004 DYNAMIC EFFECT OF FAST NEUTRON BEAMS IN A SOLID. Akhiezer, I. A.; Lazurik-El'tsufin, V. T. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 7, 1218-1220(Jul 1974). (In Russian).

The volume effect appearing in solids during the transmission of a beam of fast neutrons and resulting from the transfer of the momentum from the beam to atoms of the target materials was determined. (tr-auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstract 3518.

4005 (EUR-5110e) RIVET SEAL FOR SAFEGUARDING THE MTR FUEL ELEMENTS. Crutzen, S.; Jehenson, P.; Borloo, E.; Buergers, W. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Sep 1974. 56p. Dep. NTIS (US Sales Only) $6.00. EUR B.Fr.70.-.

The development of a rivet seal that provides a unique and tamperproof identity for MTR fuel elements is described. (TFD)

4006 (HEDL-SA-698) ACCOUNTABILITY MEASUREMENTS ON FFTF FUEL PINS AT HEDL. Goris, P. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1974. Contract AT(45-1)-2170. 25p. (CONF-740622-9). Dep. NTIS $4.25.

From meeting of Institute of Nuclear Materials Management; Atlanta, Georgia, USA (19 Jun 1974).

Accountability measurements on FFTF fuel pins by a chemical method using controlled potential coulometry, surface ionization mass spectroscopy, and a nondestructive method using a ^{252}Cf source fuel pin scanner designed and built by LASL are described. (TFD)

4007 (KFK-1109) OPTIMIZATION OF SAFEGUARDS EFFORT. Avenhaus, R.; Frick, H.; Gupta, D.; Hartmann, G.; Nakicenovic, N. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Aug 1974. 116p. Dep. NTIS (US Sales Only) $8.75.

The preparation and the mathematical treatment of an inspection model, as well as a detailed application of the theoretical considerations to a reprocessing plant of the NFS type and a fabrication plant of the ALKEM type are discussed. In the theoretical part, two possible means of diverting material are considered, i.e., diversion by means of falsification of data and diversion without falsification of data within the scope of measurement accuracy. In the first case, two different statistical models were examined. The first provides for the inspector checking the operator's data by means of sample remeasurement. In this study this is called D_1-statistics. In the second model, the inspector compares the sum of his data with the sum of all measurement data reported by the operator. This is called D_2-statistics. This will be applied if it is no longer possible for the inspector to check the batch after it has been measured by the operator. Diversion without falsification of data within the scope of measurement accuracy was examined on the basis of material balance by single and double inventory. The inspector assumes an overall probability α of the error of the first kind which is divided for the first and second inventory due to the restriction $1-\alpha = (1-\alpha_1) \cdot (1-\alpha_2)$. It is assumed that the operator diverts the amount M_1 in the first and the amount M_2 in the second inventory period under the restriction $M = M_1 + M_2$. In one instance, that is important because of its relevance to practical application, it can be shown that the optimal inspector strategy (α_1^0, α_2^0) is independent of the amount M. In Chapter III, numerical examples using reference plant data described in Chapter II are worked out. The examples are meant to demonstrate the possibilities and restrictions of the methods developed in Chapter I. This is achieved with the help of extensive parameter variations. A summary of the most important results and a reference to fields of research where future work could be of use are presented. (auth)

4008 (LA-5651-M) FUNDAMENTALS OF PASSIVE NONDESTRUCTIVE ASSAY OF FISSIONABLE MATERIAL. Augustson, R. H.; Reilly, T. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 113p. Dep. NTIS $5.45.

This manual is an introduction to the fundamental principles of passive gamma-ray and neutron assay for fissionable material accountability. The manual is written at an introductory level and requires minimal background in nondestructive assay. The philosophy is to explain the basic principles and then use specific examples to illustrate the application of these principles to practical assay problems. The first six chapters deal with gamma-ray assay including gamma-ray production and interaction, detection principles, quantitative assay, and enrichment measurements. The last three chapters discuss passive neutron measurements including basic signatures and interactions, neutron detectors, and verification measurements. Although the manual emphasizes portable instrumentation, it includes material on more advanced, nonportable equipment. Lithium-drifted germanium detectors are discussed in detail. Spontaneous fission neutron detectors are described briefly. Although this is not directly applicable to portable instrument assay, it provides valuable background material on advanced assay procedures. (JFD)

4009 (LA-5696-SR) ANALYTICAL METHODS FOR FISSIONABLE MATERIALS IN THE NUCLEAR FUEL CYCLE. Program Status Report, June 1973–June 1974. Waterbury, G. R. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1974. Contract W-7405-eng-36. 14p. Dep. NTIS $4.00.

Progress was made on the development of methods for the dissolution of difficult-to-dissolve materials, the determination of plutonium and uranium for nuclear safeguards applications, the preparation of well-characterized plutonium materials for SALE Program samples and for NBS reference materials, the analysis of IAEA and special inventory-surveillance materials, and the analysis of HTGR fuel materials. Improvements were made in a Teflon-container metal-shell apparatus used for acidic dissolution of samples at elevated temperature, and its application to a variety of difficult-to-dissolve samples was evaluated. Gamma-assay measurements for ^{235}U and ^{239}Pu were investigated for uranium-plutonium mixtures. A procedure was developed to obtain homogeneous precipitates of uranium and plutonium oxalates to serve as calibration materials for gamma assay. An advanced automated spectrophotometer, designed for the determination of plutonium and uranium, was constructed and sent to the AEC's New Brunswick Laboratory for application studies. The preparation of plutonium-containing materials for the SALE Program included plutonium nitrate solutions with >99% Pu^{4+}. A high-temperature oxidation-chlorination system, followed by an anion exchange separation and titrations, was developed for the determination of uranium and thorium in HTGR fuel. SALE uranium materials were analyzed on a monthly basis. A batch of highly pure plutonium metal was prepared, characterized, and packaged for use as a future NBS CRM. An inter-AEC-laboratory program was initiated to measure the half-lives of long-lived plutonium isotopes with high accuracy. (auth)

4010 IAEA SAFEGUARDS SYSTEM AND ITS APPLICATION IN THE CSSR. Klik, F.; Lukavsky, J.; Zoch, O. (Czechoslovak Atomic Energy Commission, Prague). Jad. Energ.; 20: No. 8, 254-257(Aug 1974). (In Czech).

Nuclear material can be diverted from civilian to military purposes and this represents the potential risk to the peace. A Non-Proliferation Treaty (NPT) has been adopted in order to limit such a risk. The general description of the IAEA Safeguards System, which task is to perform the control of nuclear material in civil industry as provided by NPT and Czechoslovak State System of Accounting for and Control of nuclear materials is presented. (auth)

4011 NONDESTRUCTIVE ASSAY OF PLUTONIUM AND URANIUM IN MIXED-OXIDES. Weber, H. J. Nucl. Mater. Manage.; 111: No. 2, 22-30(Sum 1974).

Nondestructive assay measurements were performed on mixed-oxide fuel samples with the objective of determining their Pu and U content. A total of nine mixed-oxide samples were measured, in addition to a separate set of calibration standards. The measurements were performed with a Rad Tech Isotopic Source Assay System (ISAS), which directly counts fission events by utilizing the fact that fission is characterized by a high multiplicity of particles, 7 gammas and 2.5 neutrons, on the average, simultaneously emitted in each fission event. ISAS utilizes coincidence counting techniques for the assay of fissionable materials. In most cases, the Pu content was determined within statistical uncertainties with passive measurements. Uranium was measured with similar precision for the samples containing highly enriched U. The few discrepancies between assayed results and manufacturer's records are attributable to the fact that the available set of standards was somewhat deficient in its representation of the isotopic composition and physical properties of the unknowns. Natural U in the presence of Pu was measured with poor accuracy due to the fact that the yield per gram from 90% enriched Pu was about 300 times greater than that from natural U. It is better determined on a weight basis after the Pu content is passively measured. (TFD)

4012 COMPUTERIZED RECORDS AND REPORTS SYSTEM. Tschiegg, R. E. Nucl. Mater. Manage.; 111: No. 2, 31-36(Sum 1974).

The Nuclear Materials Management and Safeguards System at Westinghouse is described. The system uses an IBM-370-55 and several programs designed to record and report transactions including special nuclear materials. The programs are briefly described. (TFD)

4013 TESTING FOR NORMALITY WHEN THE DATA ARE GROUPED DUE TO ROUNDING. Jaech, J. L. Nucl. Mater. Manage.; 111: No. 2, 40-45(Sum 1974).

The purpose of this paper is to caution the user to use care in the application of the W-test to data that exhibit a discrete nature due to rounding imposed by the limitations of the measurement process. At the same time, it is hoped that the reader will be motivated to become more aware of the assumptions underlying statistical tests in general as he applies them, both from point of view of what these assumptions are and, perhaps more importantly, with respect to their effect on the conclusions suggested by the test outcomes. The problem is treated by means of an example. (TFD)

4014 MOUND LABORATORY: A LEADER IN NUCLEAR MATERIALS MANAGEMENT. DeVer, E. A.; Rodenburg, W. W. (Monsanto Research Corp., Miamisburg, OH). Nucl. Mater. Manage.; 111: No. 2, 47-49(Sum 1974).

Activities performed at Mound Laboratory pertaining to nuclear materials management are briefly described. They include audit procedures, calorimetry as a primary assay tool, plutonium verification and standards program, shipping of radioactive materials, and waste management. An automated real-time system for controlling nuclear materials within the plant is being studied. (TFD)

Disposal and Storage

Refer also to abstracts 3040, 3044–3046, 3060, 3315, 3333, 3349, 3358, 3403, and 5278.

4015 (BNWL-SA-5001(DRAFT)) CONCEPTUAL SYSTEM FOR HANDLING ALPHA-BEARING WASTES. Jansen, G. Jr.; Schneider, K. J.; Hammond, V. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1974. Contract AT(45-1)-1830. 27p. (CONF-741026-2). Dep. NTIS $4.25.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

A system for interim management of long-lived low-level wastes by treatment/storage in stable, solid forms in Federal repositories is described and is being considered in the U. S. This system is similar to that currently planned for high level wastes. Such a system would provide protection to mankind while ultimate disposal techniques are developed. Highly preliminary studies indicate that the total cost of such a system, while much more expensive than that now in effect in the U. S., would represent less than 1% of the cost of nuclear power. The long term projections of activities and toxicities of alpha containing waste fractions indicate that ultimate disposal methods will be required and safety analysis of disposal concepts will have to deal with time spans of thousands of years. (auth)

4016 (HEDL-SA-705) QUANTITIES AND CHARACTERISTICS OF COMMERCIAL ALPHA CONTAMINATED SOLID WASTES IN THE U. S. Blasewitz, A. G.; Cooley, C. R.; Richardson, G. L. (Westinghouse Hanford Co., Richland, Wash. (USA)). 1974. 12p. (CONF-741026-3). Dep. NTIS $4.00.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

To date, most alpha-contaminated wastes have been generated in Atomic Energy Commission facilities. With the advent of a rapidly growing nuclear power industry, however, this situation has changed markedly; and within a few years, commercial operations will represent the most significant source of these wastes. Analyses are being made of the current waste generation rates and projected trends for fuel fabrication, fuel reprocessing, and reactor operations. Data regarding the volumes and plutonium content of the various waste streams, together with pertinent information concerning their physical and chemical characteristics and point of origin in the processing operations, will be compiled. The information will provide the background which is essential for the following assessments: (1) establishing areas wherein process changes could lead to an improvement in terms of reduced volume and/or plutonium content of the waste, and (2) defining areas wherein research and development are required for improved waste treatment. Studies of this nature have been started. (auth)

4017 (JABE-ARHCO-03) PHASE II SEISMIC REVIEW: WASTE STORAGE TANK VENTILATION SYSTEM, 241-A-FARM, HANFORD, WASHINGTON. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). Apr 1972. 29p. Dep. NTIS $4.50.

For Atlantic Richfield Hanford Co., Richland, WA.

The Phase II seismic analysis was performed to evaluate components of the 241-A-Farm waste storage tank ventilation system, which were critical, or could not be properly appraised on the basis of the previous Phase I qualitative review. The analysis was performed for the combined effects of normally acting loads and the Criteria Design Base Earthquake Motion. The Phase II results are summarized for the following components: Condenser Building 241-A-401; Condenser Building Hot Side Gallery Piping; Condensate Storage Tank 241-A-417; Cooling Water Storage Tank 241-A-201; Exhaust Stack in Filter Building 241-A-702; and Main Power Transformer, Switchgear, and Miscellaneous Items. (TFD)

4018 (NTIS-WIN-74-062) OCEAN WASTE DISPOSAL. A Bibliography with Abstracts. Report for 1964 – June 1974. Lehmann, E. J. (National Technical Information Service, Springfield, Va. (USA)). Aug 1974. 146p. (COM-74-11265). NTIS $20.00.

This bibliography contains 131 selected abstracts of research reports retrieved using the NTIS on-line search system–NTISEARCH. The majority of the cited topics discuss the ocean disposal of sewage, sewage sludge, and dredged material although reports on the disposal of radioactive wastes, brines and industrial wastes are also covered. The ecological effects are included as is research on the pollution of the New York Bight. Studies on the discharge of heated effluents are excluded. (auth)

4019 (ORNL-TM-4713) HYDROFRACTURE SITE PROOF STUDY AT OAK RIDGE NATIONAL LABORATORY. Weeren, H. O.; Brunton, G. D.; de Laguna, W.; Moore, J. G. (Oak Ridge National Lab., Tenn. (USA)). Nov 1974. Contract W-7405-eng-26. 46p. Dep. NTIS $5.50.

A study was carried out in FY-74 to verify that a site proposed for a new Hydrofracture Waste Disposal Facility at the Oak Ridge National Laboratory was suitable for hydrofracture operations. An injection well and four monitoring wells were drilled and cased, and a test injection was made using a grout tagged with radioisotope tracer. The results of the study indicate that the proposed site is satisfactory. (auth)

4020 UNDERGROUND WASTE MANAGEMENT. Hoernsten, A. (Sveriges Geologiska Undersoekning, Stockholm). Vannet Norden; 7: No. 3, 30-40(Sep 1974). (In Swedish).

In presenting his impressions of the symposium "Underground waste management and artificial recharge" (New Orleans, 1973), the author concentrates first on a German paper describing the disposal of low and intermediate level radioactive waste in the Asse salt mine. The geological conditions are briefly described. Future plans for high active waste disposal in glass or ceramic form are outlined. The program for monitoring groundwater in the district is briefly treated. A Canadian report on the disposal of solid waste in a subsurface site at Whiteshell is then discussed. The hydrogeolic conditions are of primary interest. Finally, the injection of liquid radioactive waste in deep geologic formations where the groundwater is so salty that it cannot be used as drinking water, and which is hydraulically separated from other groundwater which may be used as drinking water. Data on such wells in the USA are presented and safety aspects briefly treated. In conclusion the legal status of well injection in the USA is summarized. (NO)

4021 PRINCIPLES OF RADIOACTIVE WASTE MANAGEMENT. Morley, F.; Bryant, P. M. (National Radiological Protection Board, Harwell, Eng.). Environ. Change; 2: No. 6, 409-415(Feb 1974).

The management of waste in the nuclear power industry is technically complex and requires sophisticated techniques which have few parallels in other scientific and industrial fields. Some of these techniques for the management of gaseous and liquid radioactive wastes are discussed. The use of U, dosage and discharge limitations, government guidelines, and disposal techniques for liquids and gases are discussed. ^{85}Kr is cited as a global air pollutant. (Pollut. Abstr.)

4022 SEABED DISPOSAL: WHERE TO LOOK. Bishop, W. P. (Sandia Labs., Albuquerque, NM); Hollister, C. D. Nucl. Technol.; 24: No. 3, 425-443(Dec 1974).

The oceans cover more than 70% of the earth's surface, and while they contain many valuable resources, they also cover some of the most inaccessible and unproductive areas of the planet. With their ability to detoxify and disperse contaminants, the oceans have for many years been used for disposal of biological and chemical wastes, but radioactive wastes present a more complex problem in that the ocean environment cannot detoxify them. Still it appears that certain oceanic areas— the mid-plate/mid-gyre regions— may possibly offer practical and nonpunitive areas for disposal of high-level radioactive wastes. A program is now under way at Sandia Laboratories to gather the data necessary to an understanding of the features and processes of the mid-plate/mid-gyre regions. This study seeks to identify (a) the knowledge necessary for a judgment concerning their use as a repository, and (b) the areas in which that knowledge is now lacking. It is concluded that the geologic stability and relative uselessness of some mid-plate/mid-gyre ocean basin floors are sufficient justification for an objective investigation of the processes pertinent to their use as an ultimate nuclear waste repository. Far from advocating any immediate decisions to use these regions for disposal, a systematic study is both prudent and urgent in view of the nuclear waste problem. (auth)

4023 UNITED STATES ATOMIC ENERGY WASTE MANAGEMENT PROGRAMS AND OBJECTIVES. Pittman, F. K. (USAEC Div. of Waste Management and Transportation, Washington, DC). Nucl. Technol.; 24: No. 3, 273-285(Dec 1974).

An overview of the radioactive management programs being pursued by the USAEC is presented. The main disposal methods discussed include storage in retrievable surface storage facilities; disposal in geological formations; disposal in space; and transmutation. (TFD)

4024 HIDDEN COMMITMENT OF NUCLEAR WASTES. Rowe, W. D.; Holcomb, W. F. (Environmental Protection Agency, Washington, DC). Nucl. Technol.; 24: No. 3, 286-293(Dec 1974).

One of the critical factors that must be considered in the decision-making process required in solving the radioactive waste management problem is the issue of costs. The accumulation of both government- and commercially generated wastes is estimated at some 200 million gal of high-level waste, 400 million ft^3 of low-level waste, and 85 million ft^3 of alpha wastes by the year 2000. Cost projections are made for high-level waste management (exclusive of ultimate disposal), for low-level waste burial, and for alpha waste burial. These cost estimates indicate some $7 billion to be committed for waste management by the year 2000. In addition, the cost for ultimate disposal of high-level wastes could exceed $1 billion by the year 2000, depending on the government surcharge for handling these wastes. Therefore, explicit attention should be given to the possibility that an interim engineered storage system may become permanent solely due to economic costs. (auth)

4025 WASTE MANAGEMENT: LICENSING AND CRITERIA. Smiley, S. H. (USAEC Directorate of Licensing, Washington, DC). Nucl. Technol.; 24: No. 3, 294-299(Dec 1974).

Waste management is a topic of great importance to industry and the general public, and one that receives a great deal of attention within the regulatory organization. The regulated fuel cycle includes uranium milling, UF$_6$ conversion, fuel fabrication, chemical reprocessing of spent reactor fuel, transportation of nuclear materials, and waste disposal. Management of radioactive waste generated in the nuclear fuel cycle is of particular interest now. A number of policy decisions must be made in the near future and then implemented as regulatory requirements. These decisions must receive public acceptance for safety and protection of environmental values. The main issues pertain to management of high-level waste, management of plutonium bearing waste (including the fuel cladding hulls from reprocessed fuel), stabilization and long-term control of mill tailings, and the application of the "as low as practicable" concept of fuel cycle effluents in light of the current status of technology. Two important studies are presently being carried out by the U. S. Atomic Energy Commission. The first involves the assessment of the environmental effects of utilizing plutonium fuel in light-water reactors; the second is an environmental analysis of the nuclear fuel cycle associated with high-temperature gas-cooled reactor operations. Waste management is significantly represented and evaluated in each of these studies. (auth)

4026 MANAGEMENT OF RADIOACTIVE WASTES: PROGRAMS OF THE INTERNATIONAL ATOMIC ENERGY AGENCY. Jacobs, D. G. (Oak Ridge National Lab., TN). Nucl. Technol.; 24: No. 3, 300-304(Dec 1974).

The International Atomic Energy Agency was established in 1957 to serve as the agency of the United Nations responsible for international activities concerned with the peaceful uses of atomic energy. The agency was established to promote the development of peaceful uses of atomic energy and dissemination of information from those member states having well-developed programs to those just embarking upon such programs. The prevention of pollution of the seas from the discharge of radioactive waste was recognized early as a problem concerning international cooperation. From its inception the agency has devoted considerable effort toward this problem. The recent worldwide interest in preservation of environmental quality has led the agency to broaden its waste management program to include consideration of all environmental impacts associated with nuclear power, regardless of whether they are unique to nuclear power. Also, an increasing amount of attention is being given currently to the problems associated with the management of high-level and alpha-bearing radioactive wastes; the combination of the high potential hazard and the long containment time required make this problem of international concern. The international concern for these two problem areas has led to an increased scope of activities in the agency's waste management program. (auth)

4027 RADIOACTIVE WASTE MANAGEMENT IN SELECTED FOREIGN COUNTRIES. Parker, H. M. (HMP Associates, Inc., Richland, WA). Nucl. Technol.; 24: No. 3, 305-308(Dec 1974).

A panel of the National Academy of Science Committee on Radioactive Waste Management (CRWM) has been reviewing the status of waste management in various foreign countries. The objective has been to look mainly for differences between U. S. and foreign practices to identify policies or procedures that might improve technical practices or achieve equal results at lower cost. This paper is an informal summary of the findings that are expected to be reported by the CRWM in the next few months. (auth)

4028 EXTRATERRESTRIAL DISPOSAL OF NUCLEAR WASTES. Drumheller, K. (Battelle Pacific Northwest Labs., Richland, WA). Nucl. Technol.; 24: No. 3, 418-424(Dec 1974).

If a stable non-Earth intercept trajectory or orbit can be assured, extraterrestrial disposal offers the complete removal of long-lived nuclear waste constituents from Earth. The primary unfavorable features are that the concept deals with only part of the waste; possible launch safety problems exist, retrievability and monitoring are difficult, and the concept will require international agreements. Extraterrestrial disposal of the total waste constituents and of only the transuranic elements were considered. However, space disposal of the transuranics only is believed to be the most practical scheme, primarily because of the very high space transport cost per unit of weight. The implementation of space disposal of transuranic waste could be achieved with current technology. This technology is considered to include the space shuttle and the space tug, advanced vehicles that use existing engineering technology. The safety aspects for space disposal primarily include safety during launch and control of the extraterrestrial destination of the waste constituents. The potential for an abort that could cause a release of radionuclides during any one space launching is modestly high; however, relatively small amounts of waste constituents are associated with each launch; and package integrity is high even in an abort. The major energy consumption in space disposal is for propelling the waste to its final destination. This energy consumption for disposal of actinide waste is about 4 to 5 orders of magnitude less than the electrical energy from the original nuclear fuel, depending on the final space destination. (auth)

4029 MANAGEMENT OF SPENT CANDU FUEL. Morgan, W. W. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Nucl. Technol.; 24: No. 3, 409-417(Dec 1974).

Projections have been made regarding the quantities of spent fuel arising from reactors in Canada. It is concluded that for at least 75 years the waste will be manageable and the storage risk is acceptably small. Conceptual designs of several fuel storage facilities have been completed and fuel storage costs were estimated. These are in the region of 0.1 mil/kWh for all storage schemes studied. A choice of the specific interim storage facility to be used has not yet been made. However, it is believed that any of the systems described would be acceptable. (auth)

4030 DISPOSAL OF RADIOACTIVE WASTE IN BEDDED SALT FORMATIONS. McClain, W. C.; Boch, A. L. (Oak Ridge National Lab., TN). Nucl. Technol.; 24: No. 3, 398-408(Dec 1974).

The considerations involved in the evaluation of the suitability of any geological formations for the disposal of radioactive wastes are illustrated by summarizing some of the studies performed in the southeastern New Mexico region on the bedded salt concept. These investigations fall into three main categories: (1) Evaluation of the natural integrity of the formation. In addition to standard geological and hydrological studies, special investigations of the subsurface dissolutioning of the salt formation, the seismic stability of the region, and the possibility of previous mass flowage of the salt have been completed. These results will be confirmed by core drilling and testing currently in progress. (2) Evaluation of the effects of the operation of a waste disposal facility on the geological characteristics of the area over the short term. These studies include prediction of the thermal transient resulting from the radioactive decay heat deposited in the rocks and its effects, such as the migration of brine inclusions up the thermal gradients and the dehydration of moisture-bearing minerals. Other studies in this category are concerned with the possibility and consequences of radiation-induced energy storage in the salt and prediction of the deformations to be expected around the openings excavated in the the salt formations. (3) Evaluation of the effects which the operation of a repository and other activities of man may have on the integrity of the geological containment over the long periods that the waste remains hazardous. The principal analyses in this category involve the long-term deformations of the rocks overlying the repository area (including the slow development of a subsidence basin at the ground surface) and the prevention of adverse conditions resulting from penetrations of the salt by exploratory drilling for oil and gas accumulations. (auth)

4031 RETRIEVABLE SURFACE STORAGE FACILITY FOR COMMERCIAL HIGH-LEVEL WASTE. Nelson, D. C.; Wodrich, D. D. (Atlantic Richfield Hanford Co., Richfield, WA). Nucl. Technol.; 24: No. 3, 391-397(Dec 1974).

The Atlantic Richfield Hanford Company has completed engineering studies that will lead to the construction of a retrievable surface storage facility (RSSF), capable of receiving all high-level radioactive wastes generated by commercial reactor fuel reprocessing plants through the year 2000 and storing these wastes for at least 100 y. There will be approximately 75,000 canisters (1 ft dia × 10 ft long) of dry solid waste containing a total of about 200 MW of heat. These wastes must be safely stored in a manner that will have minimum adverse impact on man's environment and the ecology, and not cause undue risk to the health and safety of the public. General design criteria for the RSSF were developed and the technical feasibility of each of the following concepts was determined: (a) storage in water basins where the decay heat is rejected to the atmosphere by the use of heat exchangers and cooling towers, (b) storage in air-cooled vaults where the heat removal is by natural convection, and (c) storage in rugged thick-wall casks placed outdoors. Selection of the concept to be developed for RSSF construction will be made by the USAEC. (auth)

4032 GEOHYDROLOGIC CONSIDERATIONS IN THE MANAGEMENT OF RADIOACTIVE WASTE. DeBuchananne, G. D. (Geological Survey, Reston, VA). Nucl. Technol.; 24: No. 3, 356-361 (Dec 1974).

Nongaseous radioactive wastes occur as liquids containing high-level concentrations of radionuclides, liquids containing low concentrations of radionuclides, and solids contaminated by radioactivity. Whether released by accident or design into the earth or onto the earth's surface, only water is capable of transporting significant quantities of radionuclides away from burial sites. Geohydrologic information that must be determined to predict the velocity and direction of waste movement from a site include climate, hydrology, detailed subsurface geology, permeability, porosity, sorptive potential, seismic potential, and geologic history of the area. Since the late 1960's mathematical models have been used to make predictions of waste transport in some hydrologic systems. Intensive field investigations at each site are needed before these models can be used. (auth)

4033 HANDLING AND PACKAGING OF PLUTONIUM-CONTAMINATED WASTE. Owen, J. B. (Dow Chemical U. S. A., Golden, CO). Nucl. Technol.; 24: No. 3, 339-342(Dec 1974).

The Rocky Flats Plant generates significant quantities of waste materials and equipment which are contaminated with plutonium. Management systems and techniques have been developed and are in use which reduce both the volume of waste generated and the quantity of plutonium involved. Containers have been developed and are in use which meet the 20-year retrievability requirement of Immediate Action Directive (IAD) 0511-21. (auth)

4034 EVALUATION METHODOLOGY OF WASTE MANAGEMENT CONCEPTS. Deonigi, D. E. (Battelle Pacific Northwest Labs., Richland, WA). Nucl. Technol.; 24: No. 3, 331-338(Dec 1974).

A methodology has been developed for an overall evaluation of high-level waste disposal concepts. This methodology incorporates the following elements: technical feasibility, safety, research and development requirements, timing, costs, policy, environmental considerations, and public attitudes. Once the technical feasibility of a concept is established, the other elements are studied in parallel. Since system safety is the element of greatest uncertainty, a more detailed description of its methodology is presented. The fault tree analysis technique is used in identification of mechanisms and probabilities of possible releases of radioactive waste constituents to man's environment. A model of the geologic subsystem assists in quantifying the decontamination factors in the waste material transport process. In addition, a comprehensive dose computational model permits ready calculation of radiation doses to individuals and population groups for alternative waste disposal concepts. (auth)

4035 NUCLEAR FUEL CYCLE AND THE ISOTOPIC COMPOSITIONS. Angelo, J. A. Jr. (Florida Inst. of Tech., Melbourne); Post, R. G. Nucl. Technol.; 24: No. 3, 323-330(Dec 1974).

The heat generated by spent fuel elements and typical processing waste from both a 1000 MW(e) reference design pressurized water reactor (PWR) and 1160 MW(e) reference design high temperature gas-cooled reactor (HTGR) were calculated for times up to 1000 years. To compensate for differences in exposure, the heat generated was expressed in terms of watts of heat generated per megawatt day of exposure. Examination of both tabular data and graphical presentations of these normalized heat generation data indicates noticeable differences in the contribution of different isotopes for each system. As anticipated, the heat generation for each fuel was greatly influenced by the transmuted isotopes ^{233}Pa and ^{238}Pu for the HTGR with ^{137}Cs and ^{90}Sr for the PWR. Data provide quantitative detailed information on the thermal power output of typical processing waste for both reactor systems for the first millennium of cooling. (auth)

Handling Equipment and Procedures

Refer also to abstracts 3001, 3041, 4867, 5335, and 5423.

4036 (AD-780586) NUCLEAR SAFETY EVALUATION TESTING OF THE AERO 51B TRAILER/MHU RAIL SET FOR THE AGM-69 (SRAM) SYSTEM. Final Report, February–July 1973. Krek, F. T. (Air Force Special Weapons Center, Kirtland AFB, N. Mex. (USA)). Apr 1974. 66p. (AFSWC-TR-73-31). NTIS $3.75.

Nuclear safety evaluation tests were performed on an AERO 51B munitions handling trailer and MHU-71/E missile handling rail set combination. The trailer was towed singly and configured for transporting AGM-69 (SRAM) system components. As a result of testing, it is recommended that the AERO 51B munitions handling trailer be nuclear safety certified for use with the AGM-69 (SRAM) system when incorporated with the MHU-71/E guided missile handling rail sets. The test procedures, test data, notation of test observations, and other pertinent information are presented. (auth)

4037 (ARH-2940) PROGRAM FOR FIRE PROTECTION: CAVES, CANYONS, AND HOT CELLS. Semiannual Report, May 1, 1973–October 31, 1973. Lee, H. A. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 14 Dec 1973. Contract AT(45-1)-2130. 17p. Dep. NTIS $4.00.

The purpose of this program is to establish the theoretical and practical basis for providing suitable fire protection systems for nuclear caves, canyons, and hot cells. Its objective is to develop data and information for the design of fire detection and extinguishing equipment and methods for protection of these critical nuclear facilities from fire or the release of radioactive material as the result of fire. The results are to be used as the basis for a guide to be published at the conclusion of the program. Areas of investigation reported include: fire extinguishment; fire detection; protection of filters during fires; effect of ventilation control on fire suppression; effect of solvent temperature on the ignition and burning process; and effect of airborne contamination from burning radioactive solvents. (auth)

4038 (BNWL-SA-4868(Rev. 2)) ANOMALIES OF CRITICALITY. Clayton, E. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1974. Contract AT(45-1)-1830. 66p. Dep. NTIS $6.50.

During the development of nuclear energy, a number of apparent anomalies have become evident in nuclear criticality. Some of these have appeared in the open literature and some have not. Yet, a naive extrapolation of existing data, without knowledge of the anomalies, could certainly lead to potentially serious consequences. The following anomalies are considered: (1) relationship between criticality in finite spheres and reflected cubes; (2) effect of added scatterers on the criticality of infinite slabs; (3) a small mass concept whereby criticality could be achieved with less than an ounce of fissile material in the form of a single small foil ≈0.2 mil thick; (4) laser-induced microexplosion involving the initiation of a supercritical event in a highly compressed, small pellet of Pu containing as little as 10^{-2} g Pu; (5) effects of progressive water flooding on the criticality of interacting arrays of fissile materials in storage vaults; (6) effect of mixing metal and fissile bearing aqueous solutions together in the same vault; (7) criticality of coupled fast-thermal systems composed of small plutonium metal spheres surrounded by aqueous plutonium-bearing solutions; (8) criticality of slightly enriched uranium and the negative buckling core; (9) homogeneous aqueous mixtures of ^{235}U and ^{238}U, wherein it would be possible to achieve criticality (over limited concentration ranges) with a smaller quantity of ^{235}U in the form of low enriched U than if the ^{235}U were in the highly enriched form; (10) interacting finite cubic arrays of metal units wherein an unmoderated array of 30.0% ^{235}U enriched spheres might have a lower critical lattice density, and hence ^{235}U mass, than an array of 93.2% ^{235}U enriched spheres; (11) effects of density changes in spherical cores with weakly absorbing reflectors (external moderation); (12) insertion of a neutron absorbing control rod into a Pu solution sphere wherein the effect of this was to cause the assembly's reactivity to initially increase as the rod entered the solution; (13) appearance of critically unbounded regions (of infinite masses) for slightly enriched uranium; (14) criticality in the earth; (15) criticality in the universe; (16) an apparent chain reaction which took place in the Republique of Gabonaise some 100 million years ago with low (3 wt% ^{235}U) enriched uranium; (17) criticality of even-n nuclides beginning with the naturally occurring element $^{231}_{91}$Pa; (18) beyond Californium projection of the "micro" critical mass for the doubly-closed shell, super-heavy magic nuclei of the future; and (19) neutron multiplication and the power reactor (four billion watts and subcritical). (auth)

4039 (BNWL-SA-5100) CRITICALITY OF HETEROGENEOUS SYSTEMS: UO_2-PuO_2 SOLIDS IN FISSILE SOLUTION CONTAINING GADOLINIUM NITRATE. Lloyd, R. C.; Clayton, E. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1974. Contract AT(45-1)-1830. 4p. (CONF-741017-20). Dep. NTIS $4.00.

From meeting of the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

The application of neutron absorbers for criticality prevention in fuel cycle operations can permit the safe handling of large quantities of material with reduced probability of criticality. If, however, soluble poisons are to be considered as either a primary or secondary means of criticality control, their use must be based on a firm knowledge of the effects of the absorber. To provide confirmatory data, a series of criticality experiments was performed to determine the effectiveness of soluble poison (gadolinium nitrate) on criticality of a heterogeneous assembly of FFTF-type fuel pins in Pu-U nitrate solution. The arrangement simulates the simplest approach to a possible dissolver configuration, wherein during the dissolution process, a heterogeneous system of solids in fissile solution (the partly dissolved fuel) would prevail. The fuel assembly was composed of a lattice of 301 fuel pins positioned in a 55.5 cm ID stainless steel vessel. This vessel was in turn contained within a larger cylindrical vessel providing for water reflection. The U-Pu nitrate solution, containing varying amounts of gadolinium, was added to the loaded lattice assembly to obtain criticality through variation on solution height. The experimental data, together with the fuel pin description and chemical makeup of the solutions, are given. The gadolinium proved to be very effective in this system. In the absence of the gadolinium poison the lattice-solution assembly became critical at a solution height of only 19.2 cm, whereas, with 1.3 g Gd/liter the critical solution height was increased to 68.9 cm. The H/Pu ratio for the fuel pin solution combination was ~86. The results of theory-experiment comparisons utilizing ENDF/B cross sections and the KENO Monte Carlo Code are presented and discussed. (auth)

4040 (SAND-74-5393) TASK ANALYSIS SCHEME WITH IMPLICATIONS FOR SUPERVISORY CONTROL OF REMOTE MANIPULATORS. McGovern, D. E. (Stanford Univ., Calif. (USA). Dept. of Mechanical Engineering). 1974. 5p. (CONF-741022-2). Dep. NTIS $4.00.

From IEEE systems, man and cybernetics conference; Dallas, Texas, USA (2 Oct 1974).

A method of task analysis for remote manipulators based on studies of manual control performance is discussed. Results from one type of task are given for two different manipulator systems and the human hand. The implications of these results for supervisory control are indicated. (auth)

4041 (TID-26286) NUCLEAR CRITICALITY SAFETY. Proceedings Held Near Taos, New Mexico, May 7–11, 1973. O'Dell, R. D. (ed.). (New Mexico Univ., Albuquerque (USA). Dept. of Nuclear Engineering). 1974. 180p. Dep. NTIS $7.60.

Separate abstracts were prepared for 4 of the 19 papers included. Abstracts for 5 of the remaining papers have previously appeared in NSA. No abstracts were prepared for 2 panel discussions and 8 work-discussion sessions that are included in the proceedings. (JWR)

For abstracts of individual papers see: 3059, 4042, 4043, and 4867.

4042 (TID-26286, pp 16-24) CONSEQUENCES OF CRITICALITY ACCIDENTS. Seale, R. L. (Univ. of Arizona, Tucson). 1974.

In nuclear criticality safety.

Several industrial criticality accidents and their consequences are reviewed. Factors influencing the magnitude of criticality accidents are examined and some benchmark experiments are discussed. Some observations on process design for criticality control are presented. (JWR)

4043 (TID-26286, pp 34-55) CRITICALITY EXPERIMENTS AND DATA. Paxton, H. C. (Los Alamos Scientific Lab., NM). 1974.

In nuclear criticality safety.

Facilities and methods for experiments on criticality control are described and some specific experiments are reviewed. The need for further criticality data in formulating standards for fissile material handling is discussed. Some applications of ^{238}Pu and ^{244}Cm are presented and the associated criticality control problems are mentioned. Criticality control problems in the recovery of plutonium from lean solutions are also examined. (JWR)

4044 HANDLING AND EMISSION CONTROL OF TRITIUM IN THE MANUFACTURE OF TRITIUM TARGETS. Fabian, H. (NUKEM GmbH, Hanau, Ger.). pp 259-274 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556–.

The processes, methods, and protection measures involved in the manufacture of tritium targets as well as the facilities and equipment used for the processing are presented. It is outlined that tritium can be handled without considerable emission and without risk of incorporation, if appropriate measures are taken and adequate facilities and equipment are employed. (auth)

4045 EQUIPMENT AND METHOD FOR THE LIFTING AND LOWERING OF A TRANSPORT CONTAINER FOR NUCLEAR FUEL INTO AND OUT OF A STORAGE TANK. Jones, C. R. (to Transfer Systems, Inc., North Haven, Conn. (USA)). German Patent 2239421/A/. 22 Mar 1973. 29p. (In German). 10 figs.

The described equipment consists of a main lifting appliance over the storage tank to lift and lower the transport container in the tank, and of an additional lifting and carrying device for the transport container which is anchored in the storage tank. The transport container is picked up and carried together with the main lifting appliance. The patent deals with the technical details and their functions. (GE)

4046 EQUIPMENT FOR THE STORAGE OF SPHERICAL PIECE GOODS. Nolten, E.; Patay, J.; Sckuhr, P. (to Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). German Patent 2149134/S/. 5 Apr 1973. 11p. (In German). 4 figs.

The equipment is used particularly to store spherical fuel elements for nuclear reactors as well as for reprocessing plants. It consists of a helical configuration of tubes around a coaxially arranged hollow cylinder provided with a motor-driven screw conveyor. (GE)

4047 COST/BENEFIT CONSIDERATIONS OF NUCLEAR POWER. Rudman, R. L. (Electric Power Research Inst., Palo Alto, CA). Nucl. Technol.; 24: No. 3, 309-313(Dec 1974).

A cost/benefit analysis has been used in an attempt to place the societal costs associated with nuclear power into perspective by comparing them with the costs associated with coal-fired plants. Generation of electricity from coal is assumed to represent an acceptable risk in our society. The results of this qualitative evaluation indicate that nuclear power compares favorably with coal for the following costs: resource depletion, environmental insult, cost of power generation, voluntary occupational health risks, and involuntary public health risks associated with routine plant operation. Plant accidents, waste disposal techniques for both nuclear and coal-fired stations, and the nuclear safeguards issue are identified as the major areas requiring further risk evaluation. (auth)

Transportation

4048 (BNWL-SA-5044) HIGH EXPOSURE PLUTONIUM FUELS FROM LIGHT WATER REACTORS. Faust, L. G.; Brackenbush, L. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1974. Contract AT(45-1)-1830. 20p. (CONF-741106-1). Dep. NTIS $4.00.

From 22nd conference on remote systems technology; Washington, District of Columbia, USA (Nov 1974).

Some of the radiation problems which are expected to occur during the shipping and handling of plutonium produced in light water reactors in the years 1975 through 1985 are presented. Current methods for shipping plutonium from a processing plant, fabricating the plutonium into mixed oxide fuel elements, and shipping the fuel elements to reactors will have to be changed.

Several methods for estimating photon and neutron dose equivalents are presented with some suggestions to reduce the extent of personnel radiation exposure problems. (auth)

4049 (KY-498) UF_6 CYLINDER TESTING. Fortune, M. B.; Green, C. H. (Paducah Gaseous Diffusion Plant, Ky. (USA)). 19 Aug 1965. Contract W-7405-eng-26. 19p. Dep. NTIS $4.00. Declassified 10 Jul 1974.

To investigate possible deterioration of cylinders used in handling and shipping UF_6, ten 10-ton type "P" and ten 2-½-ton cylinders were hydrostatically tested at 200 psig, and one of each type of cylinder was cut open for internal inspection. Also, special corrosion studies were conducted to determine the susceptibility of the cylinder steel to stress corrosion in liquid UF_6. It was concluded from the tests that internal damage by UF_6 had been very minor and the only apparent deterioration was from external corrosion and handling damage. (auth)

4050 (SRL-74-002) COMBINATION SHIPPING AND WELDING CASK FOR BUTT WELDING "TEFZEL" LEADERS TO ^{252}Cf SEED ASSEMBLIES. Walker, V. W.; Permar, P. H. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Sep 1974. 27p. Dep. NTIS $4.50.

As part of its ^{252}Cf Market Evaluation Program, the USAEC provides ^{252}Cf neutron sources to medical institutions for the evaluation of ^{252}Cf in cancer therapy. Because ^{252}Cf seeds (half-life 2.65 years) cannot be discarded as conveniently as ^{192}Ir seeds, each evaluator is supplied with a reusable set of ^{252}Cf seed assemblies (3 to 7 seeds each) from which he may select the assemblies required for any given irradiation. Because each patient will have different requirements for number of seeds and length of the leader attached to the seeds, a butt-welding technique was devised to allow the user to affix leaders of any desired length to the ^{252}Cf seed assembly. After being implanted, the leaders are trimmed as required, and at the conclusion of the irradiation the ^{252}Cf seed assemblies are removed, cleaned, and returned to storage. The equipment and technique for unloading the shipping cask and for butt-welding "Tefzel" leaders to the "Tefzel"-sheathed ^{252}Cf seed assemblies are described. The $n + \gamma$ radiation dose to the welding operator was measured using the welding procedures described. These irradiation dose data provide a guide for the evaluator on the expected dose due to the butt-welding operation. (auth)

4051 MODEL CODE FOR THE TRANSPORT OF DANGEROUS GOODS BY ROAD. 2nd Edition. Melbourne; Australian Department of Transport (1973). vp.

The purpose of this model code is to set down requirements for the transport of dangerous goods by road (including radioactive materials). The model code is based on recommendations by a United Nations Committee of Experts on the transport of dangerous goods. (AT)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 3537, 3538, 4569, 4570, and 5429.

4052 (BNL-19125) SNEAP 73: SYMPOSIUM OF NORTHEASTERN ACCELERATOR PERSONNEL, BROOKHAVEN NATIONAL LABORATORY, SEPTEMBER 12, 13, 14, 1973. Thieberger, P.; Lindgren, R. A. (Brookhaven National Lab., Upton, N.Y. (USA)). [nd]. 373p. (CONF-7309122-). Dep. NTIS $21.75.

The program of activities and talks and discussions on electrostatic accelerators are presented. Topics by session include ion sources; charging systems; accelerator tubes; the upgrading of existing accelerators; terminal systems and problems with heavy ion beams; and Dynamitrons, Pelletrons, and Laddertrons. (WHK)

4053 (BNL-19275) REPORT TO THE HIGH ENERGY DISCUSSION GROUP, DECEMBER 6, 1973. Berley, D. (Brookhaven National Lab., Upton, N. Y. (USA)). 12 Jul 1974. 16p. Dep. NTIS (U. S. Sales Only) $4.00.

A summary of the AGS experimental program and a review of some of the facilities being planned were discussed at the Dec. 6, 1973 meeting of the High Energy Discussion Group. Among these were (a) a status report of the MPS, (b) a review of the superconducting particle beam transport equipment, and (c) a new design for a low energy separated beam. (auth)

4054 (CERN-74-9(Vol.1), pp 34-44) SPS: A EUROPEAN PROJECT. Adams, J. B. (CERN, Geneva). 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

A technical description of the Super Proton Synchrotron is presented, followed by details about the origins and the construction period of the SPS project. Emphasis is laid on relationships between machine designers and builders, European industry, research physicists, and the financing by the Member States. (auth)

4055 (CERN-74-9(Vol.1), pp 47-66) HIGH-PRECISION SURVEY AND ALIGNMENT TECHNIQUES IN ACCELERATOR CONSTRUCTION. Gervaise, J. (CERN, Geneva). 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

Basic concepts of precision surveying are briefly reviewed, and an historical account is given of instruments and techniques used during the construction of the Proton Synchrotron (1954 to 59), the Intersecting Storage Rings (1966 to 71), and the Super Proton Synchrotron (1971–). A nylon wire device, distinvar, invar wire and tape, and recent automation of the gyrotheodolite and distinvar as well as auxiliary equipment (polyurethane jacks, Centipede) are discussed in detail. The paper ends summarizing the present accuracy in accelerator metrology, giving an outlook of possible improvement, and some aspects of staffing for the CERN Survey Group. (auth)

4056 (EPIC/MC-60) PRELIMINARY EPIC SITE INVESTIGATION. Gray, D. A. (Science Research Council, Chilton (UK). Rutherford Lab.). Aug 1974. 30p. (RL-74-129). Dep. NTIS $4.50.

A report on site investigation for the Electron Proton Intercepting Complex, known as EPIC, is presented. A major part of this project requires the construction of a 3.5 m square tunnel about 2.4 kms long. Additional buildings, tangential access tunnels and beam projector stations along the tunnel perimeter also form part of the project. The geology and field work are described (including some general notes on the boring method used) together with ground conditions and laboratory testing. The proposed site is expected to be mainly in the Lower Chalk, and the engineering properties of this rock are discussed in relation to the stringent design requirements of the EPIC project. (UK)

4057 (JINR-P16-8176) NEUTRON ENERGY SPECTRA OUTSIDE THE SHIELDING OF HIGH ENERGY PROTON ACCELERATORS. Aleinikov, V. E.; Gerdt, V. P.; Komochkov, M. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 14p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The method of statistical regularization was applied to unfolding the spectra of neutrons which have passed through the shielding of high-energy proton accelerators. Measurements of neutron energy spectra using a Bonner spectrometer outside the shielding of a 660 MeV proton synchrocyclotron are presented. (auth)

4058 (LA-5770-PR) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Report for the Period Ending July 31, 1974. Dunn, E. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1974. Contract W-7405-eng-36. 54p. Dep. NTIS $5.45.

Topics include engineering support, accelerator systems development, electronic instrumentation and computer systems, accelerator operations, large spectrometer systems, research, and practical applications of LAMPF. Also, a report of the LAMPF Users Group is included. (WHK)

4059 (LAL-1275) PROGRESS REPORT. (Ecole Normale Superieure, 91-Orsay (France). Lab. de l'Accelerateur Lineaire). Jul 1974. 122p. (In French). Dep. NTIS (US Sales Only) $9.25.

The report is divided into six sections devoted to a description of the laboratory, the work in physics, technical activities related with the operation of the accelerator, construction of the large collision ring DCI, auxiliary activities related to use of the light of synchrotron radiation by external devices, and administration and documentary problems. In the area of physics, the polarization of the beam in the ACO, the production of hadrons beyond resonance, and rare decay modes of the meson were studied. Continuing studies on neutrino physics and hadron physics are reported. The experiments made in collaboration with CERN are briefly reported. In an appendix, publications, internal reports and articles published in periodicals are tabulated. (JSR)

4060 NUCLEAR STRUCTURE FACILITY OF 20/30 MV TANDEM ACCELERATOR. Tait, N. R. S.; Voss, R. G. P. (Science Research Council, Daresbury, Eng.). Particle Accel.; 5: No. 4, 181-197(Dec 1973).

A large electrostatic accelerator has been designed to provide a nuclear structure facility in Britain. The machine is intended to operate initially at 20 MV with subsequent upgrading to 30 MV. The general features of the accelerator are described and the main dimensions are specified. The electrostatic design and beam optics of the machine are discussed and a description is given of the design and layout of the stack, intershield and centre terminal. An extensive high voltage test programme is under way using a variety of dc and pulsed sources, and surge phenomena in Van de Graaff accelerators are being studied both theoretically and experimentally using surge measurement devices that are under development. Details are also given of a high current inductive charging system and a number of other devices such as a fast data link employing a light diode and a color TV operating in conjunction with a small computer. The general layout of the facility is described and some details are given of the control and counting room, the experimental areas, and of shielding wall thicknesses. (auth)

4061 DISTRIBUTION OF THE NEUTRON CURRENT ALONG THE AZIMUTH OF AN ELECTRON SYNCHROTRON. Roslik, S. F. Kratk. Soobshch. Fiz.; No. 2, 10-13(1974). (In Russian).

The azimuthal distribution of the neutron current was measured on a synchrotron with electrons accelerated up to 600 MeV. Formulas and methods of calculation were given for predicting the neutron current at selected distances from the accelerator in the orbit plane. (tr-auth)

Auxiliaries and Components

Refer also to abstract 3495.

4062 (ANU-P-597) VACUUM NOTES: II. Ophel, T. R. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Jul 1974. 76p. Dep. NTIS (US Sales Only) $7.00.

Over the last two years, the installation of the 14UD tandem accelerator has led to major changes in vacuum practice in the laboratory. Apart from the different methods required to attain clean, hydrocarbon-free systems operating below 10^{-6} torr, problems of pressure monitoring, system protection, oil-free roughing and leak-detection have been evaluated. A standard system of protection was developed for the beam lines of the 14UD target area. Various gauges were investigated and suitable gauge control units designed and built. Since many of the units in use on the EN tandem were nearing or had reached the end of their useful life, the 14UD techniques were extended to the tandem beam lines to provide uniformity throughout the laboratory. The vacuum protection and gauging units and the leak detection system for the beam line systems of the 14UD and EN accelerators are described. Also, specifications for the beam line fittings are given. (WHK)

4063 (BNL-tr-577) PULSED CASCADE TRANSFORMER. Venevtsev, I. T.; Skoromnyi, G. M.; Revutskii, E. I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). [nd]. Translated by S. J. Amoretty from pp 69-71 of KHFTI-73-13. 10p. Dep. NTIS $4.00.

Supplying high-voltage pulses of the required shape to the injectors of linear accelerators, while keeping the design of the facility compact and simple, is a difficult task. A high-voltage pulsed cascade transformer (HPCT) with voltage $U_p = 600$ kV, pulse duration $\tau_p = 500$ μsec, and maximum power $P = 500$ kW for the injector of the proton linear accelerator (PLI-10) is described. (WHK)

4064 (BNL-tr-579) HIGH-VOLTAGE POWER SUPPLY FOR A HIGH-CURRENT INJECTOR. Venevtsev, I. T.; Skoromnyi, G. M.; Ptukhina, Z. E.; Revutskii, E. I.; Verbovskii, V. V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). [nd]. Translated by S. J. Amoretty from pp 66-68 of KHFTI-73-13. 9p. Dep. NTIS $4.00.

The high-voltage power supply for the injector being developed at the Physico-Technical Institut of the Ukrainian Academy of Sciences must meet the following specifications: voltage $U_v = 600$ kV with 0.5% instability, load current during the pulse $I_{1p} = 0.2$ A, pulse duration $\tau_{1p} = (600$ to $800)$ μsec, and repetition rate $\gamma = 50$ sec^{-1}. Fairly large I_{1p} and τ_{1p} and high stability were the key factors in choosing the high-voltage generator. The most suitable generator for this purpose at present is the symmetrical cascade generator (CG), which can produce I_{1p} up to 0.5 A, τ_{1p} up to several msec, and U_v up to 800 kV with an instability $\leq 0.01\%$ (with stabilization) for γ up to hundreds of hertz. A schematic of the CG-600 cascade generator is given and described. (WHK)

4065 (CERN-74-9(Vol.1), pp 67-84) MAGNETIC AND ELECTROSTATIC DEFLECTING DEVICES. Middelkoop, W. C. (CERN, Geneva). 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

A short description is given of a number of deflecting devices in use at CERN, with emphasis on some of their technological aspects. In particular, the cyclotron magnet, the Split-Field Magnet at the ISR, and the magnet of the 2 m Liquid-Hydrogen Bubble Chamber are discussed, as well as the magnets of the synchrotron lattices of the Proton Synchrotron, Intersecting Storage Rings, and Super Proton Synchrotron. In addition, some remarks are made on the technology of septum magnets and fast pulsed magnets. Finally, the application and the technology of electrostatic separators and electrostatic septa are described. (auth)

4066 (CERN-74-9(Vol.1), pp 85-97) SUPERCONDUCTIVITY. Thomas, D. B. (Rutherford Lab., Chilton, Eng.). 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

A short general review is presented of the progress made in applied superconductivity as a result of work performed in connection with the high-energy physics program in Europe. The phenomenon of superconductivity and properties of superconductors of Types I and II are outlined. The main body of the paper deals with the development of niobium–titanium superconducting magnets and of radio-frequency superconducting cavities and accelerating structures. Examples of applications in and for high-energy physics experiments are given, including the large superconducting magnet for the Big European Bubble Chamber, prototype synchrotron magnets for the Super Proton Synchrotron, superconducting dc beam line magnets, and superconducting RF cavities for use in various laboratories. (auth)

4067 (CERN-74-9(Vol.1), pp 98-110) CRYOGENICS. Firth, M. (CERN, Geneva). 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

The paper reviews some physical properties of materials at low temperatures and the general techniques which are used to produce and maintain temperatures in the liquid–hydrogen and liquid–helium region. Applications of low-temperature technology encountered in high-energy physics are described, with particular reference to refrigeration, hydrogen and polarized targets, liquid hydrogen bubble chambers, superconducting devices and condensation cryopumping. (auth)

4068 (CERN-74-9(Vol.1), pp 120-128) COMPUTER CONTROL APPLIED TO ACCELERATORS. Crowley-Milling, M. C. (CERN, Geneva). 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

The differences that exist between control systems for accelerators and other types of control systems are outlined. It is further indicated that earlier accelerators had manual control systems to which computers were added, but that it is essential for the new, large accelerators to include computers in the control systems right from the beginning. Details of the computer control designed for the Super Proton Synchrotron are presented. The method of choosing the computers is described, as well as the reasons for CERN having to design the message transfer system. The items discussed include: CAMAC interface systems, a new multiplex system, operator-to-computer interaction (such as touch screen, computer-controlled knob, and non-linear track-ball), and high-level control languages. Brief mention is made of the contributions of other high-energy research laboratories as well as of some other computer control applications at CERN. (auth)

4069 (KFK-EXT.-3/74-7) BULK AND SURFACE PROPERTIES OF NIOBIUM. Hauser, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Jul 1974. 60p. (In German). Dep. NTIS (US Sales Only) $6.00.

In order to obtain good superconducting cavities for rf accelerators and separators, the surface preparation is crucial but not yet very well controlled and understood, which is shown by orders of magnitude changes of the attained rf surface resistances and breakdown fields. To control the surface treatments and to improve the understanding of Nb surfaces, the critical temperature T_c and the magnetic field penetration depth $\lambda(T)$ as function of temperature were measured in the superconducting state for various surface treatments, together with a dc resistance ratio RRR measured in the normal conducting state. The measurements were carried out using Nb cylinders (ϕ 10 mm, length 70 mm), which in the furnace have a cooling behavior similar to Nb cavities. (auth)

4070 (LA-5649) PERFORMANCE OF PULSED 805-MHz, 1.25-MW KLYSTRONS INTO MISMATCHED LOADS. Jameson, R. A.; Mills, R. S.; Cady, R. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 186p. Dep. NTIS $7.60.

High-power 805-MHz klystrons are being used in the LAMPF linac as pulsed amplifiers at 12% duty factor. These amplifiers drive resonant loads in a dynamically controlled mode where output field must be held to 1% in amplitude and 1° in phase despite 20 to 30% load disturbances. Because high efficiency is desired, operation occurs in the nonlinear region near saturation. The power-transfer characteristics of the klystron are studied into mismatched loads of complex reflection coefficients up to 0.75. Data are presented as a function of rf drive in the form of two- and three-dimensional Rieke diagrams and as power-transfer and dynamic-gain curves. Appendixes cover tube characteristics, experimental and data reduction techniques, and error analysis. (auth)

4071 (LNF-74/28(R)) NUMERICAL CALCULATIONS FOR SYNCHROTRON RADIATION: APPLICATION TO ADONE. Montelatici, V. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 21 May 1974. 40p. (In Italian). Dep. NTIS (US Sales Only) $5.00.

A general graphic method for the determination of the luminous intensity of synchrotron radiation is developed. It is applied to the calculation of the synchrotron radiation of Adone. (JSR)

4072 (NP-20221) CONSTRUCTION AND CALIBRATION OF A STRIP LINE PROTOTYPE PHASE COMPARATOR FOR USE ON THE 70 MeV INJECTOR. Ellis, J. E.; Perera, N.; Sandels, E. G. (Science Research Council, Chilton (UK). Rutherford Lab.). Jul 1974. 22p. (RL-74-120). Dep. NTIS (US Sales Only) $4.25.

Transmission line power dividers, phase detectors and phase shifters are required in low power (1 Watt) rf monitoring systems of the 70 MeV Injector. The transmission line can either be of strip or coaxial form. The strip line was chosen because it can be fabricated easily by employing printed circuit techniques. This paper describes the development of a prototype phase detector and phase shifter, these being combined in a single unit to form a phase comparator for use in auto-tuning systems for the tanks and debuncher, and in monitoring intertank phases. (auth)

4073 (ORNL-tr-2872(DRAFT)) DETERMINATION OF MAGNET DISCHARGE CIRCUITS. Wittgenstein, F. 8 May 1972. Translation by Martha Gerrard of BEBC/MA-68. 22p. Dep. NTIS $4.25.

Design and construction of the rapid discharge protection system for the superconducting BEBC bubble chamber magnet with a stored energy of 800 MJ are described. Parameters and calculations for the circuit design are given. (WHK)

4074 (RL-74-030) BEAM TOROID CURRENT MONITOR SYSTEM FOR NIMROD 70 MeV INJECTOR PROJECT. NPAG Design Specification No. 42. Connolly, J. F.; Gilby, A. S. (Science Research Council, Chilton (UK). Rutherford Lab.). 28 Jan 1974. 5p. Dep. NTIS (US Sales Only) $4.00.

Details of the design specification are presented under the following headings: beam toroid units, combined head amplifier and line driver units, transmission cable, signal processing unit, control. (UK)

4075 (RLN-74-104) BASQUE SUPERCONDUCTOR SOLENOID. Gallagher Daggitt, G.; Micklewright, C.; Dawson, J.; Brown, J. (Science Research Council, Chilton (UK). Rutherford Lab.). 1974. 87p. Dep. NTIS (US Sales Only) $7.50.

An operation and instruction handbook for Basque superconductor solenoid beam line elements is presented. Topics include system commissioning, the superconductor solenoid, the cryostat, the power supply, and cryostat and solenoid instrumentation. (WHK)

4076 PROFILE AND CONTAMINATION OF AN ELECTRON BEAM. Romano, G. (Rome Univ. (Italy). Istituto di Fisica). Nucl. Instrum. Methods; 119: No. 3, 615-617(1 Aug 1974).

Profile and γ-ray contamination of an electron beam have been measured by means of plastic track detectors. The influence on nitrocellulose of high radiation doses is discussed. (auth)

4077 RADIATION MEASUREMENTS IN SECONDARY ELECTRON BEAM AND COMPARISON WITH CALCULATIONS. Kase, K. R.; Nelson, W. R.; Keller, L. (Stanford Univ., CA). Health Phys.; 27: No. 3, 243-249(1 Sep 1974).

A high energy particle beamline is described which is capable of transporting a high intensity electron beam to potentially occupied areas. Ionization chamber measurements of electron beam intensity are described together with the ion chamber calibration and necessary corrections. The results of the measurements are compared with a Monte Carlo calculation of the electron intensity. (auth)

4078 CURRENT INTEGRATOR FOR ACCELERATED PARTICLE BEAMS USED FOR ABSOLUTE CROSS-SECTION MEASUREMENTS. Popescu, D. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 25: No. 10, 1151-1159(1973). (In Rumanian).

This work describes a low cost precision integrator for particle beam currents down to 5×10^{-10}A. An experimental setup is presented in which a careful calibration and some tests are made. The influence of secondary electrons is studied. The absolute cross-section is also checked in a concrete case. (auth)

4079 CURRENT LOSSES DURING RECUPERATION OF ENERGY FROM A BEAM OF ACCELERATED ELECTRONS IN A LONGITUDINAL MAGNETIC FIELD. Blinov, P. I.; Dolgachev, G. I.; Kozlov, A. A.; Slivkov, I. N. (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 328-329(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 31-32(1974).

The construction of a collector which is sectioned in the transverse direction is described for systems with recuperation of the electron energy. The collector has a shallow depth and is transparent in the longitudinal direction. The dependence of the screened-out current to the accelerating electrode on the operating mode is determined. (auth)

Ion Sources and Injection and Extraction Systems

Refer also to abstract 4537.

4080 (BNL-19197) DEVELOPMENT OF INTENSE NEGATIVE HYDROGEN ION SOURCES AT BNL. Prelec, K.; Sluyters, T. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 7p. (CONF-741019-9). Dep. NTIS $4.00.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

Early in 1973 a program was initiated at BNL to develop a pulsed source of negative hydrogen ions capable of yielding beam currents of several tens of milliamperes or more for charge exchange injection of protons into the AGS. Two types of sources were constructed, a hollow discharge duoplasmatron and a magnetron. Both sources were operated without and with cesium vapor injection. A substantially higher output of H^- ions was observed from a hydrogen-cesium discharge, i.e., of the order of ten milliamperes from the duoplasmatron source and of the order of hundred milliamperes from the magnetron. Current densities at the extraction aperture and beam phase space areas are comparable to those of standard proton sources. (auth)

4081 (BNL-19209) NEGATIVE HYDROGEN SOURCES FOR BEAM CURRENTS BETWEEN ONE MILLIAMPERE AND ONE AMPERE. Sluyters, T. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 12p. (CONF-741019-10). Dep. NTIS $4.00.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

Collision processes in hydrogen plasmas; charge exchange collisions in hydrogen and alkali vapors; charge exchange sources; and plasma negative ion sources including Penning sources, the hollow discharge duoplasmatron, and magnetron sources are discussed. (44 references) (WHK)

4082 (CEA-CONF-2668) EXPECTED ENERGY-SPREAD IN THE EXTRACTED BEAM OF SATURNE II. Bruck, H.; Laclare, J. L.; Leleux, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Section d'Optique Corpusculaire). 1974. 6p. (CONF-740522-39). Dep. NTIS (US Sales Only) $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

Nuclear spectroscopy in the range of medium energy (~ 1 GeV) needs a good duty cycle and extracted beam little dispersed in energy (< 10^{-3}). To meet these requirements it is possible to slowly extract the beam in a resonant mode so as to give an instantaneous momentum spread small compared to the stored one. For this purpose it is proposed to slowly push the stored beam into the resonance $3\nu = 11$ by means of a betatron acceleration in order to avoid the creation of structure. In the framework of this method a simple formula was developed in good agreement with computer results giving the dispersion in energy of the beam as a function of the principal parameters of the extraction. A numerical example is given applicable to the new design of Saturne II (proton accelerator in the range 0.5 to 2.7 GeV). (auth)

4083 (LA-UR-74-1351) PERFORMANCE OF THE LAMPF H^- INJECTOR. Allison, P. W.; Meyer, E. A.; Mueller, D. W.; Stevens, R. R. Jr. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 12p. (CONF-741019-7). Dep. NTIS $4.00.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

The 750-keV H^- injector for LAMPF was designed to provide a beam of modest intensity to be accelerated simultaneously with a 17-mA H^+ beam in the LAMPF linac. A positive hydrogen ion beam is extracted at 20 kV from a duoplasmatron and then passed through a hydrogen charge-exchange canal for partial conversion to H^- ions. The source has been operated at a current of up to 1-mA peak with a duty factor of up to 6% (i.e., 120 Hz, 500 μs) for linac injection during the past year. A peak current of 2.1 mA has been reached in off-line tests. Design features of the injector and future plans are presented. (auth)

4084 (LA-UR-74-1355) POLARIZED H^- SOURCE FOR LAMPF. McKibben, J. L.; Stevens, R. R. Jr.; Allison, P.; Hardekopf, R. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 7p. (CONF-741019-8). Dep. NTIS $4.00.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

A polarized source is being constructed for the Los Alamos Meson Physics Facility (LAMPF). This source will be an H^- source in order that the polarized beam can be accelerated simultaneously with an intense H^+ beam. The Lamb-shift type of source was chosen and will be located within the large terminal of a 750-kV Cockcroft-Walton (C-W) generator. Several features are being incorporated to increase the intensity available, since the duty factor of LAMPF is only 6%. The basic feature of our design is that the source will accommodate a larger size of metastable beam in order to better match the emittance of the beam to the acceptance of the argon cell. A magnetic lens located about 20 cm downstream from the acceldecel lens will hopefully increase the intensity but requires that the bore of the cesium cell be increased from 1 cm to about 2.5 cm. The spin filter will be markedly shortened to increase the output beam. The argon cell will be pumped cryogenically using a 10-W helium-cycle refrigerator operating at about 15°K. The lens system will be similar to that in the unpolarized H^- source. Apparatus for rapidly reversing the direction of polarization is described. (auth)

4085 PREPARATION AND PROPERTIES OF A THERMIONIC SODIUM ION SOURCE. Schlagheck, W.; Moeller, W. (Bochum Univ. (F. R. Germany). Inst. fuer Experimentalphysik). Nucl. Instrum. Methods; 120: No. 1, 189-191(15 Aug 1974).

A new thermionic sodium ion source has been developed using nepheline ($Na_2O \cdot 2SiO_2 \cdot Al_2O_3$) as emitter substance. The preparation method of the substance and the conditioning procedure of the source are described, which are based on the mineralogical properties of the compound. Current yield, mass spectrum, and long-run properties of the source are reported. (auth)

4086 THE BRIGHTNESS AND EMITTANCE OF THE NEGATIVE ION BEAM EMITTED BY A MIDDLETON SPUTTER SOURCE. Doucas, G.; Hyder, H. R. M. (Oxford Univ. (UK). Nuclear Physics Lab.). Nucl. Instrum. Methods; 119: No. 3, 413-421(1 Aug 1974).

The emittance and brightness of a 20 keV negative carbon beam produced by a Middleton-type surface ionization source have been measured. For 50% of the total negative beam, the emittance is 6.5 mm mrad $(\mathrm{MeV})^{1/2}$ and the average brightness about 1.0 $\mathrm{nA/mm^2mrad^2}$. The total beam size has also been measured and found to decrease slightly with energy and beam intensity. Various factors that contribute to the emittance of the negative beam are also discussed. (auth)

4087 A LITHIUM ION SOURCE FOR CYCLOTRON EXTERNAL INJECTION. Luches, A.; Provenzano, L.; De Michele, G. (Istituto di Fisica, Università di Lecce, Lecce, Italy). Rev. Sci. Instrum. 45: No. 8, 1028-1028 (Aug 1974).

A lithium ion source of the Blewett–Jones type has been assembled and tested for radial injection into the CSATA cyclotron. Ion currents up to 1.5 mA at the extractor are obtained. The extracted beam is focused at the cyclotron vacuum chamber port by a quadrupole doublet. The injected ion current is 500 μA. (auth)

4088 LITHIUM ION NEUTRALIZER. D'yachkov, B. A.; Nestrenko, V. M.; Petrusha, V. Yu. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 333-336(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 35-39(1974).

The construction is described and test results are presented for a lithium ion neutralizer having an aperture 45 mm in diameter and a jet density ~0.5×10^{16} atoms/cm^2, in which circulation of Li is achieved. The neutralizer is a vacuum-pure charge-exchange target that may be used in thermonuclear installations with injection of neutral high-energy particles (hundreds of kiloelectronvolts), in installations with charge-exchange injection, and in charge-exchange accelerators. (auth)

4089 INJECTOR OF NEGATIVE HYDROGEN IONS HAVING A CURRENT OF 20 mA. Dimov, G. I.; Roslyakov, G. V. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 330-332(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 33-35(1974).

A pulsed beam of negative hydrogen ions having a duration of 200 μsec and a current of 20 mA with an energy of 1 MeV was obtained at the output of a Van-de-Graaff accelerator. The singularities of a charge-exchange force of H^- ions which is mounted in the high-voltage electrode of the accelerator are described. The beam is used to obtain a compensated closed proton beam. (auth)

Ion Optics and Field Calculations

4090 (CEA-CONF-2669) INSTABILITIES DETECTED IN SATURNE. Faure, J.; Leleux, G.; Lemaire, J. L.; Vienet, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). 25 Apr 1974. 6p. (CONF-740522-40). Dep. NTIS (US Sales Only) $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

After the injection energy had been increased from 3.6 MeV to 20 MeV, some problems arose at Saturne. The theoretical number of captured particles is about 6×10^{12}. This figure corresponds to a ν_z shift from 0.88 to 0.5. But we did not succeed in accelerating more than 1.6 to 2×10^{12}. Moreover, it was very difficult to keep particles up to the end of the accelerating process. Strong losses appeared in the first 100 ms together with occasional coherent oscillation phenomena in both directions. In order to overcome these difficulties, we empirically created horizontal magnet field index variation for coherent oscillation damping and we had to work out some cumbersome radial exploration during the acceleration process. This refined tuning depended upon the beam intensity and was unstable from pulse to pulse. These difficulties were especially inconvenient for resonant extraction because of the necessary good optical properties of the beam needed for this extraction type and of the imposed magnetic field index variation. The experimental and theoretical studies undertaken are described. (auth)

4091 ION OPTICAL PROPERTIES OF AN ACCELERATOR SYNCHRONIZED TRANSVERSE ALTERNATING ELECTRIC FIELD. Krueger, F. R. (Technische Univ. Darmstadt (F. R. Germany). Inst. fuer Kernphysik). Nucl. Instrum. Methods; 119: No. 3, 605-610(1 Aug 1974). (In German).

The beam-transport properties of an electric radiofrequency field are calculated. The field is synchronized to the beam-repetition frequency of the heavy-ion accelerator and is situated transverse to the ion beam. At certain values of the parameters of the system the deflection of the ions does not depend linearly on their velocity. There is a combination of such fields which is not only achromatic relative to the velocity but also to the specific charge. This is useful concerning the task of separating heavy ions. (auth)

4092 ANALYTIC FIELD FORMS IN AXIALLY SYMMETRIC SYSTEMS. Bosi, G. (Moncton Univ., New Brunswick (Canada). Dept. of Physics). Nucl. Instrum. Methods; 119: No. 3, 613-614 (1 Aug 1974).

An analytic expression for the scalar potential in axially symmetric systems is proposed. The given solution, which applies whenever the field form in the symmetry plane is known, is obtained as an extension of earlier solutions carried out by various authors. (auth)

4093 CERTAIN CHARACTERISTICS OF VARIABLE-PHASE FOCUSING IN PROTON LINEAR ACCELERATORS. Vlasov, A. D. Sov. J. At. Energy (Engl. Transl.); 36: No. 2, 163-164(Feb 1974).

Translated from At. Energ. (USSR); 36: No. 2, 134(Feb 1974).

A comparison of thermal losses in an accelerator with variable-phase focusing with those of an "etalon" accelerator with autophasing is given. An expression is obtained for the ratio of the powers of these losses. (WHK)

4094 ACCELERATING OF ELECTRONS INTO RESONANCE CAVITIES WORKING IN THE E_{010} MODE. Oproiu, C. (Inst. of Atomic Physics, Bucharest); Teodorescu, I. E. Stud. Cercet. Fiz.; 26: No. 3, 275-282(1974). (In Rumanian).

The possibilities of accelerating electrons injected at very low energy into a cylindrical cavity working in the E_{010} mode are discussed. A computer is used to describe the particle trajectories and energy spectrum, the phase angle of the electromagnetic fields, and the focusing effect during acceleration. (auth)

4095 EXPERIMENTS ON THE ACCELERATION OF ELECTRONS IN A BETATRON WITH CONSTANT GUIDING FIELDS. Kanunnikov, V. N.; Mikhalev, P. S. Kratk. Soobshch. Fiz.; No. 1, 38-45(1974). (In Russian).

Experiments, made on the electron ring phasotron of the Institute of Physics, showed that in a betatron with a constant guiding field for acceleration of beams with intensity above 10^{14} e/sec can be obtained. (tr-auth)

Storage Rings

Refer also to abstracts 3548 and 4101.

4096 (CERN-74-9(Vol.1), pp 111-119) ULTRA-HIGH VACUUM. Fischer, E. (CERN, Geneva). 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

This paper mentions first the requirement of ultra-high vacuum (UHV) for storage rings with colliding beams, and then describes how, in the mid-1950's, the fast development of UHV technology made the construction of the Intersecting Storage Rings (ISR) possible with their 2 km of vacuum pipes at 10^{-11} Torr. The performance features are discussed with special emphasis on the problem of stimulated gas desorption from chamber walls. The placing of contracts for sputter-ion pumps and the need for developing sector valves at CERN is mentioned to illustrate that there was some feedback from these constructions to the general development of UHV. Finally, some problems and solutions are listed which are common to other fields where UHV is used: namely in thermonuclear fusion, space research, and manufacturing of integrated circuits. (auth)

4097 (EPIC/MC-43) VACUUM REQUIREMENTS FOR THE PROTON RING OF EPIC. (Science Research Council, Chilton (UK). Rutherford Lab.). [nd]. 29p. (RL-74-025). Dep. NTIS (US Sales Only) $4.50.

The effects of the vacuum on the circulating proton beam in EPIC are estimated. A proton circulating round the ring may collide with the residual gas in the vacuum chamber, causing the particle to be lost by (a) elastic (Rutherford) scattering through an angle too large to be accepted by the ring; (b) inelastic (Nuclear) scattering, and (c) multiple elastic scattering which gradually increases the emittance of the beam eventually leading to loss to the walls of the vacuum chamber. In addition to these effects are (d) the gradual loss of energy of the beam by ionizing collisions and resultant straggling; (e) loss of energy in elastic collisions, and (f) the increase in gas pressure due to desorption from the chamber walls when ionized residual gas atoms are accelerated out of the beam by the space charge of the beam itself. It is concluded that for no more than 10% decrease in luminosity in 10 hours of circulation the mean vacuum pressure should not exceed 6×10^{-10} mm. (WHK)

4098 VERY-HIGH-LUMINOSITY INSERTIONS FOR THE CERN INTERSECTING STORAGE RINGS. Montague, B. W.; Zotter, B. W. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 120: No. 1, 9-16(15 Aug 1974).

The luminosity of the CERN ISR could be brought into the range of 0.5 to 2×10^{33} $\mathrm{cm^{-2}\ s^{-1}}$ by modifications in the vicinity of one interaction region. The high luminosity is obtained by a combination of near-zero crossing angle, low beta and vanishing momentum compaction at the intersection point. The attainable performance will depend on wether or not superconducting magnetic elements are used, the maximum tolerable level of the electromagnetic beam-beam interaction, and the available stacked proton current. Provision is made in the design for adjusting the crossing angle to achieve the optimal conditions. (auth)

4099 MOELLER SCATTERING OF WEAKLY EXCITED OSCILLATORS. Ternov, I. M.; Khalilov, V. R.; Chizhov, G. A. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 4, 411-418 (1974). (In Russian).

Consideration is given to the noncoherent scattering of weakly excited electrons applicable to ring accumulator conditions (effect of Tushek). It is assumed that before scattering each of the electrons was in a certain quantum state n with an assigned distribution of probabilities of various momentum values for a given n. The effect of transverse polarization of electron spins on the scattering process was investigated. (SJR)

Experimental Facilities

Refer also to abstracts 3536 and 4059.

4100 (CEA-CONF-2667) SATURNE II: PROPOSAL OF A RENOVATED PROTON FACILITY AT SACLAY. Bruck, H.; Laclare, J. L.; Leleux, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Section d'Optique Corpusculaire). 24 Apr 1974. 4p. (CONF-740522-38). Dep. NTIS (US Sales Only) $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

The Saturne proton synchrotron at Saclay will be transformed into a strong focusing machine to be used essentially for nuclear spectroscopy. The advantages of a circular machine for such a purpose are outlined. The shortcomings of weak focusing are analyzed and essential parameters of the transformed machine are given. (auth)

4101 (CERN-74-9(Vol.1), pp 155-166) SYNCHROTRON RADIATION. Kunz, C. (DESY, Hamburg). 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

The production of synchrotron radiation as a by-product of circular high-energy electron (positron) accelerators or storage rings is briefly discussed. A listing of existing or planned synchrotron radiation laboratories is included. The following properties are discussed: spectrum, collimation, polarization, and intensity; a short comparison with other sources (lasers and x-ray tubes) is also given. The remainder of the paper describes the experimental installations at the Deutsches Elektronen-Synchrotron (DESY) and DORIS storage rings, presents a few typical examples out of the fields of atomic, molecular, and solid-state spectroscopy, and finishes with an outlook on the use of synchrotron radiation in molecular biology. (auth)

4102 (EUR-5157e) MONTE CARLO CALCULATIONS FOR THE MODERATOR OF THE PULSED NEUTRON TARGET OF THE GEEL LINAC. Bignami, A.; Coceva, C.; Simonini, R. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy)). Sep 1974. 40p. Dep. NTIS (US Sales Only) $5.00. EUR B. Fr. 50.-.

The results are reported of Monte Carlo calculations which were performed to compare the characteristics of two different dispositions of the moderator near the pulsed neutron target of the Geel linear accelerator for neutron time-of-flight experiments. The resolution function is obtained for the disposition eventually chosen. The effect of different flight-path directions on the resolution is evaluated. (auth)

4103 (LA-5746-MS) NEUTRON ENERGY FLUX AND DOSAGE IN THE LAMPF π^- BIOMEDICAL CHANNEL. Goodman, C. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1974. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

Rough working estimates are obtained from published data for the neutron energy flux and dosage for use of experimenters at the LAMPF Biomedical Channel. This compilation emphasizes the need for experimental confirmation of the several Monte Carlo theoretical predictions which have been made and are being made in preparation for π^- therapy of humans in the near future. (auth)

4104 THE BEMS-2 ON-LINE ISOTOPE SEPARATOR AT THE JINR HEAVY-ION CYCLOTRON. Karnaukhov, V. A.; Bogdanov, D. D.; Demyanov, A. V.; Koval, G. I.; Petrov, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). Nucl. Instrum. Methods.; 120: No. 1, 69-76(15 Aug 1974).

The BEMS-2 on-line isotope separator operated in a heavy-ion beam employs a high-temperature surface-ionization ion source. The design features of the ion source with an external target are described. The recoil effect occurring in heavy-ion reactions is used to transport the radioactive isotopes under investigation into the source cavity through a 1.4 μm tantalum entrance foil. The operational characteristics of the ion source for Cs and Ba isotopes are studied. The average hold-up time of the activity in the ion source, τ, which is determined by the diffusion of recoils from the catcher, is measured. The value of τ depends on the temperature and type of the catcher used. For a tantalum catcher $\tau \sim 1.0$ s at T = 2500°C, and the value of τ increases with decreasing temperature. In the case of a tungsten catcher, the hold-up time is several times longer. The ion source efficiency for Ba is equal to 30 to 50%. (auth)

4105 LIQUID HELIUM-II TARGET FOR PRECISION MEASUREMENTS OF PION CROSS SECTIONS. Meyer, H. O. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 120: No. 1, 143-146(15 Aug 1974).

A target of superfluid helium has been developed for the purpose of measuring pion total cross sections. The diameter of the cylindrical target cell is 7.57 cm. The absolute target thickness is known to be better than 0.1%. (auth)

4106 I. TRANSMISSION OF REACTION PRODUCTS THROUGH CAPILLARY TUBES. Zirnheld, J. P. (Strasbourg-1 Univ., 67 (France)). Nucl. Instrum. Methods; 120: No. 1, 171-177(15 Aug 1974).

A method to study the transmission of nuclear reaction products through capillary tubes by simulation with clusters created in a discharge is presented. It is pointed out that the flow rate of the carrier gas and the cluster size play important roles. Some simple formulas for computing the gas flow rate either in the laminar streaming case or in the intermediate one are given. After a brief consideration on the cluster adsorption process, an expression is derived for the transmission which is verified by experiments. In the calculation of the reaction product losses in capillary tubes the decay of the radioactive species has been explicitly taken into account. (auth)

4107 II. TRANSMISSION OF REACTION PRODUCTS THROUGH A NOZZLE-SKIMMER SYSTEM. Zirnheld, J. P. (Strasbourg-1 Univ., 67 (France)). Nucl. Instrum. Methods; 120: No. 1, 179-185(15 Aug 1974).

In order to connect the high pressure part of a fission fragment separator to the low pressure one, a nozzle-skimmer system is used. The properties of this apparatus have been studied, simulating the reaction products by clusters created in an aerosol generator. The main feature of such a device consists in its ability to give lower downstream pressure while passing most of high mass fragments. These two characteristics are examined both from an experimental and a theoretical point of view. In particular some simple expressions are given to calculate the gas and cluster jet shape as a function of the distance from the nozzle from which one can derive the gas and cluster flux through a skimmer. (auth)

4108 TRANSPORT OF RECOIL ATOMS IN A STREAM OF LIQUID-AIR-COOLED PURE HELIUM. Aeystoe, J.; Hillebrand, S.; Hellmuth, K. H.; Valli, K. (Jyvaeskylae Univ. (Finland). Dept. of Physics). Nucl. Instrum. Methods; 120: No. 1, 163-169 (15 Aug 1974).

Pure commercial helium cooled down to the temperature of liquid air (80 K) has been used for rapid transportation of recoil atoms over distances as long as 10 m. Transport efficiencies of several tens of per cent have been obtained for recoil atoms resulting from alpha decay or from decay by fission. The angle of divergence of the beam of recoil atoms at the exit of the transport capillary is measured to be (11 ± 2)° for particles of mass number A = 211. Experimental results are discussed in terms of thermal diffusion. The elimination of carrier vapors will probably simplify the use of the helium-jet technique in on-line mass separators. (auth)

4109 A NEW METHOD OF TIME-OF-FLIGHT SPECTROSCOPY WITH AN INCOMPLETELY PULSED CYCLOTRON BEAM. Siebert, B.; Jahr, R. (Physikalisch-Technische Bundesanstalt, Braunschweig (F. R. Germany)). Nucl. Instrum. Methods; 119: No. 3, 445-450(1 Aug 1974).

For use of a cyclotron in time-of-flight spectroscopy an internal deflection system located near the ion source can be employed to pulse the internal cyclotron beam. If an accelerated pulse of ions is extracted by any method different from the single-turn extraction method then the finite radial width of the pulse of ions may lead to one or more advanced and retarded pulses in the extracted beam which accompany the main pulse.

It is shown that such a beam is still suited for neutron time-of-flight spectroscopy, since the "true" spectrum can be inferred by mathematical decomposition of the measured spectrum. A careful error analysis is included in the discussion. (auth)

4110 METHOD OF ENSURING A REPRODUCIBLE ADJUSTMENT OF DOSE HOMOGENEITY IN THE RADIATION FIELD OF A PARTICLE ACCELERATOR. Dorschner, H.; Heger, A. (to VEB Textilkombinat Cottbus). British Patent 1,355,973. 12 Jun 1974. 2p.

Reference is made to pulsed particle accelerators. It may happen that due to lack of synchronization between the scanning frequency and the beam current frequency an undesirable non-uniform distribution of the beam power over the irradiation width will occur. The aim of the system described is to obviate this disadvantage. It is based on the fact that the scanning frequency and the beam current pulse frequency are in a constant ratio and, in addition, the phase position of the deflecting voltage is displaceable in relation to the leading edge of the beam current pulses, the frequencies being such that each pulse provides a radiation dose over the entire width of the field during scanning. It is thereby ensured that the distribution of beam power of each pulse over the width to be irradiated can be reproducibly adjusted, which is necessary for example for the uniform irradiation of planar objects. (UK)

4111 MULTIPLE BRAGG REFLECTION MONOCHROMATORS FOR SYNCHROTRON X RADIATION. Beaumont, J. H.; Hart, M. (Oxford Univ.). J. Phys., E (London); No. 10, 823-829(Oct 1974).

New designs of crystal spectrometers involving multiple Bragg reflections are described. Using synchrotron radiation from the National Institute Northern Accelerator (NINA) as a source, monochromatic x ray intensities in the region of 1 A are measured for two such devices made from perfect single crystals of silicon. The output intensity for one of these with an energy resolution of 5.6×10^{-5} is found to be 10^7 times greater than that obtained using a conventional 0.8 kV bremsstrahlung source. Comparisons are made with other sources and applications are discussed. (auth)

4112 GAS-THERMOSTATED LARGE LIQUID HYDROGEN TARGET FOR EXPERIMENTS WITH L-MESON BEAM. Dmitrevskii, Yu. P.; Mel'nik, Yu. M.; Prudkoglyad, A. F.; Sytnik, V. V.; Vasil'ev, L. M. (Inst. of Physics of High Energy, Alma-Ata, USSR). Cryogenics; 14: No. 10, 564-567(Oct 1974).

A liquid hydrogen target, containing 250 l of liquid hydrogen, with a ratio between the working space and the reservoir of 1.5 : 1, is described. A radiation shield cooled by evaporating gas is used to insulate the target. The diameter of the beam windows is 30 cm. Mean quantity of hydrogen along the beam is 14.35 g cm^{-2}, the amount of other matter along the beam is 0.75 g cm^2, and across the beam is 2.75 g cm^2. Uncertainty in target length is not more than 1.5%, liquid hydrogen evaporation is 5 litres per day, and operating time with refills is 20 days. (auth)

4113 NEUTRON GENERATORS FOR RADIOTHERAPY. Hofmann, E. G. (Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Hamburg (F. R. Germany). Fachgebiet Flugwesen und Sondertechnik). Strahlentherapie; 147: No. 6, 564-572(Jun 1974). (In German).

From 54th meeting of the Deutsche Roentgengesellschaft and 13th meeting of the Oesterreichische Roentgengesellschaft; Vienna, Austria (12 Apr 1973). 7 figs.; 4 tabs.; 10 refs.

Clinical application of neutrons was started before the fundamental research was completed and before the therapeutic potentialities were explored. The requirements concerning the equipment for neutron therapy and the different technical possibilities for the production of fast neutrons are discussed. Recently, DT-generators became especially important. The technical function of such DT-equipment, developed for clinical use, is discussed by the example of the Dynagen apparatus at the University Hospital of Hamburg-Eppendorf. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

4114 ATOMS AND MOLECULES IN ASTROPHYSICS. Proceedings of the Twelfth Session of the Scottish Universities Summer School in Physics, August 1971. Carson, T. R.; Roberts, M. J. (eds.). New York; Academic Press, Inc. (1972). 379p. (CONF-710859-). $23.40.

The conference included 14 papers. Separate abstracts were prepared for each paper. (JFP)

For abstracts of individual papers see: 4115, 4230–4237, 4295, 4344, 4461, 4462, and 4545.

4115 INTRODUCTION TO MOLECULAR SPECTRA. Foley, H. M. (Columbia Univ., New York). pp 155-199 of Atoms and Molecules in Astrophysics. Carson, T. R. (ed.). New York; Academic Press, Inc. (1972).

From 12th session of Scottish Universities summer school in physics atoms and molecules in astrophysics; Stirling, UK (Aug 1971). See CONF-710859-.

The study of molecular spectra covers the molecular wave equation, properties of electronic states, rotation and vibration, symmetry and statistics, electric dipole matrix element selection rules, vibration—rotation and rotation spectra, spin–orbit interaction and higher order rotational effects, rotation of polyatomic molecules, molecular hyperfine structure, emission and absorption, astrophysical observations, and the astrophysical molecules. (JFP)

Cosmic Radiation

Refer also to abstracts 3455–3457, 4200, 4276, 4574, and 4731.

4116 (LA-5505-C) PROCEEDINGS OF CONFERENCE ON TRANSIENT COSMIC GAMMA- AND X-RAY SOURCES, LOS ALAMOS, SEPTEMBER 20–21, 1973. Strong, I. B. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 317p. (CONF-7309107-). Dep. NTIS $7.60.

Thirty-nine papers are included. Separate abstracts were prepared for twenty-seven. (MHR)

For abstracts of individual papers see: 3456, 3457, and 4117–4141.

4117 (LA-5505-C, pp 1-9) TIME VARIABILITY OF COSMIC GAMMA-RAY EVENTS. Klebesadel, R. W. (Los Alamos Scientific Lab., NM). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

Certain of the more important properties of gamma-ray bursts are outlined, in particular the energy fluxes, durations and temporal variations. It is shown how, in many cases, one is able to derive a certain amount of directional information from the differences in time of arrival of the signal at a given pair of satellites, thus defining a circle on the celestial sphere on which the sources should lie. (MHR)

4118 (LA-5505-C, pp 10-15) DIRECTIONS OF THE COSMIC GAMMA-RAY SOURCES. Strong, I. B. (Los Alamos Scientific Lab., NM). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

Establishing the distance to an individual source by identifying it with an astronomical object of known distance is discussed. Ways of doing this and the difficulties involved are described. (MHR)

4119 (LA-5505-C, pp 16-22) GAMMA-RAY BURSTS SEEN BY UHURU. Koch, D. (American Science and Engineering, Cambridge, MA); Gursky, H.; Tananbaum, H.; Kellogg, E. Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

Observations of gamma-ray bursts detected by the UHURU satellite seen in coincidence with bursts detected by the Vela satellites are presented. Since the launch of UHURU on 12 December, 1970, twelve bursts have been observed by the Vela satellite. Data from the UHURU satellite exist for eight of these events. It is concluded that the bursts appear to be cosmic in origin, photon in nature, multiply pulsed, and have fluctuations with a time scale of a fraction of a second, which persists for the entire duration of the event. The location of the events indicate that they are either very local or extragalactic. (MHR)

4120 (LA-5505-C, pp 23-32) IMP-6 OBSERVATIONS OF THE ENERGY SPECTRA OF COSMIC GAMMA-RAY BURSTS. Cline, T. L.; Desai, U. D. (Goddard Space Flight Center, Greenbelt, MD). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

The occurrence of intense, short bursts of 0.1- to 1.2-MeV cosmic gamma rays recently found multiple Vela satellites (Klebesadel et al., 1973) was confirmed with measurements from the IMP-6 satellite. Observations regarding times of occurrence, photon flux, and temporal and spectral characteristics of the bursts are consistent. Since the IMP-6 instrument incorporates a hard x-ray detector with active particle rejection and full-time omnidirectional particle intensity monitoring, the results confirm and establish the hard x-ray or gamma-ray of the incident flux. Detailed differential energy spectra were obtained with the IMP-6 for six of the eight known events occurring during the March 1971 to September 1972 lifetime of the instrument. (MHR)

4121 (LA-5505-C, pp 33-44) UCSD OSO-7 OBSERVATIONS RELATED TO COSMIC γ-RAY EVENTS. Ulmer, M. P. (Univ. of California, San Diego). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

The UCSD OSO-7 results concerning the γ-ray events first reported by the Vela Los Alamos group are summarized. There were 5 of these events which occurred during the presently analyzed OSO-7 observations in 1972: January 17, March 12, March 28, May 14, and November. Certainty is felt only in detecting the May 14 event, but the data are consistent with respect to the detection or lack of detection of the other Vela events. (MHR)

4122 (LA-5505-C, pp 45-48) IMP-6 OBSERVATIONS OF SMALL-SIZED CANDIDATE COSMIC GAMMA-RAY BURSTS. Cline, T. L.; Desai, U. D. (Goddard Space Flight Center, Greenbelt, MD). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

It is pointed out that observations from IMP-6 may make possible the detection of a number of cosmic gamma-ray bursts in addition to those previously catalogued by the Los Alamos observers. (MHR)

4123 (LA-5505-C, pp 49-60) OBSERVATION OF A GAMMA-RAY BURST FROM THE ESRO TD-1A SATELLITE. Voges, W.; Pinkau, K. (Max-Planck-Institut fuer Extraterrestrische Physik, Garching, Ger.). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

The detection of the 1972 May 14 γ-ray burst with a large area scintillation counter of the TD-1A experiment S133 is reported. A list of possible candidates for γ-burst events is presented. (auth)

4124 (LA-5505-C, pp 61-71) COUNTING RATE GLITCHES IN THE UCSD COSMIC X-RAY TELESCOPE ON OSO-7. Wheaton, W. A.; Ulmer, M. P.; Baity, W. A.; Peterson, L. E. (Univ. of California, San Diego, La Jolla). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

One of many spikes in the counting rates in UCSD's x-ray telescope on OSO-7 has been identified with a real cosmic γ-ray burst. If a number of the others can be established as genuine, it should be possible to find approximate positions (~7° error radius) for some. As the rate is too high for most to be real, we solicit confirming coincidences with the data of others, to which end we have available a list of candidate events. (auth)

4125 (LA-5505-C, pp 74-80) DETECTION OF POSSIBLE HARD X-RAY BURSTS FROM APOLLO 15/16. Gorenstein, P. (Harvard College Observatory, Cambridge, MA); Bjorkholm, P.; Harnden, F. R. Jr. Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

Large increases in count rate of short duration resembling bursts were detected in soft x-ray detectors during twenty hours of observation during the trans-Earth coast of Apollo 15 and Apollo 16. The most apparent explanation for the large increases is that they are cosmic x-ray bursts that have longer duration and softer spectra than those discovered by the Vela satellites. However, in the absence of any positive indication to the contrary they could be pulses of electrons that one encounters in the plasma sheet between the Earth and Moon. If the events are not true hard x-ray bursts they at least indicate what is observed in thin window (0.001" Be) x-ray detectors operating between the Earth and the Moon. If the events seen by Apollo are indeed x-ray bursts there would be significant consequences. (MHR)

4126 (LA-5505-C, pp 81-91) ELECTRON DETECTOR ON BOARD THE OGO-5 SATELLITE AS A DETECTOR FOR THE COSMIC GAMMA-RAY BURSTS. L'Heureux, J. (Univ. of Arizona, Tucson). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

Gamma-ray bursts of cosmic origin have recently been detected by instruments on the Vela satellites (Klebesadel, Strong and Olson, 1973). In an effort to independently confirm the presence of the bursts, the data from our electron detector on board the OGO-5 satellite has been re-examined. Of the 11 bursts not associated with any solar activity and which occurred while our instrument was active, only the event of June 30, 1971 has been detected. The intensity of this burst is calculated to be approximately 100−200 photons/cm^2 sec for photons of energy greater than 150 keV and an upper limit of 50 protons/cm^2 sec has been placed for the intensity above 5 MeV. Since the other 10 events have not been detected by our instrument, their intensity was therefore less than one third of the intensity of the June 30, 1971 event. (auth)

4127 (LA-5505-C, p 92) SEARCH FOR GAMMA RAY BURSTS WITH THE GAMMA RAY MONITOR ON OSO-7. Forrest, D. J.; Tsai, C.; Chupp, E. L. (Univ. of New Hampshire, Durham). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

A search was carried out for evidence of increased counting rates associated with five reported Vela gamma ray bursts using the gamma ray monitor on OSO-7. The burst times studied occurred on 17 January 1972, 12 and 28 March 1972, and 1 November 1972. The only evidence for an increase from these bursts occurred on November 1, 1972. During this event the front slab showed a factor of two increases above its normal 10^3 cts/sec rate for one reading at 18:57:40 UT. (MHR)

4128 (LA-5505-C, p 98) UPPER LIMIT TO THE NUMBER INTENSITY DISTRIBUTION OF COSMIC GAMMA-RAY BURSTS. Bleach, R. D. (Univ. of Maryland, College Park); Kurfess, J. D.; Johnson, W. N. III. Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

A search for gamma-ray bursts was made using data gathered in a balloon-borne gamma-ray detector during two flights in October 1970. A NaI(Tl) crystal with an effective area of ~800 cm^2 was flown at ~4 gm/cm^2 residual atmosphere. Data obtained in the 100 to 400 keV energy range were used in this analysis. (MHR)

4129 (LA-5505-C, pp 100-106) COSMIC X-RAY BURSTS OBSERVED WITH THE OGO-5 SATELLITE. Kane, S. R.; Mahoney, W. A.; Anderson, K. A. (Univ. of California, Berkeley). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

A search of the OGO-5 x-ray data for evidence of cosmic x-ray bursts at the times of the cosmic γ-ray bursts reported by Strong et al. (1973) has revealed six events which were simultaneously observed by the OGO-5 and Vela satellites. A preliminary description of the OGO-5 events is presented. It is found that the OGO-5 experiment is a sensitive detector of cosmic x-ray bursts. (auth)

4130 (LA-5505-C, pp 107-119) X-RAY OBSERVATIONS OF THE TRANSIENT SOURCE CEN XR-4. Evans, W. D.; Belian, R. D.; Conner, J. P. (Los Alamos Scientific Lab., NM). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

The transient x-ray source CEN XR-4 was observed by instruments aboard the Vela 5A and 5B satellites at periodic intervals for about two months. The discovery of this source was first announced by Conner et al. (1969, Ap. J. Letters, 157, L157), and the initial results for the time history of the x-ray emission were described by Evans et al. (1970, Ap. J. Letters, 159, L57). Further analysis of the data has provided a more accurate x-ray light curve and confirmed the large changes in spectral shape that occurred during the first week of observations. An improved location and a smaller error box have been determined. The candidate star S5003 CEN first suggested by Eggen and Rodgers (1969, Ap. J. Letters, 158, L111) lies approximately one degree outside the present error box. The x-ray emission from CEN XR-4 was highly variable, especially during the first week of observation. On July 9, 1969, during the first observational period after the appearance of the source, large (factor of two) variations occurred in times of a few minutes. After the first week the short term variations were observed only occasionally, but 50% variations in a few hours were common. No evidence for periodic variations has been found. The total time integrated flux in the 3−12 keV energy range was (1.2 ± 0.1) erg/cm^2, and the peak observed flux was $(5.0 \pm 0.5) \times 10^{-7}$ ergs/cm^2-sec. For a thermal bremsstrahlung spectrum, extrapolation to the optical region predicts an apparent visual magnitude brighter than 12 (allowing one magnitude for interstellar extinction and one magnitude for self-absorption in the source) for a period of 5 weeks between July 13 and August 17, 1969. For purposes of comparison with other x-ray sources, the assumption of the arbitrary distance of 500 parsecs gives a total x-ray energy emission of $\approx 4 \times 10^{43}$ ergs and a peak x-ray luminosity of $\approx 1.5 \times 10^{37}$ ergs/sec. (auth)

4131 (LA-5505-C, pp 122-125) EVIDENCE FOR A GALACTIC ORIGIN OF GAMMA-RAY BURSTS. Strong, I. B. (Los Alamos Scientific Lab., NM). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

The distribution in galactic longitude of the gamma-ray sources is plotted. It is concluded, tentatively, that the sources of the gamma-ray bursts are galactic, at distances of one hundred to a few hundred parsec and are probably associated with the type I stellar population. (MHR)

4132 (LA-5505-C, pp 128-132) SOME GROUND-BASED TECHNIQUES FOR INVESTIGATING TRANSIENT PHENOMENA. Mongain, E. O. (University Coll., Dublin). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

Work done to detect transient electromagnetic phenomena is indicated. The experiments were encouraged by the work on gravitational pulses and by the theories of supernova emission which suggested a sharp initial pulse of radiation. These experiments covered the following: searches for electromagnetic pulses over a large solid angle, $(\sim 2\pi)$, searches for electromagnetic pulses from specific areas of the sky, and ground based possibilities for the gamma-ray bursts. (MHR)

4133 (LA-5505-C, pp 133-146) SEARCHES FOR IONOSPHERIC EFFECTS OF X-RAY BURSTS, AND FOR BURSTS OF RADIO EMISSION, GRAVITATIONAL RADIATION, AND MICROWAVE EMISSION FROM ASTRONOMICAL SOURCES. Drever, R. W. P. (Univ. of Glasgow); Meikle, W. P. S.; Hough, J.; Bland, R.; Lessnoff, G. W.; Jelley, J. V.; Delaney, T.; Palumbo, G. Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

A brief account is given of four separate experiments designed to search for impulsive emission of energy in various forms from astronomical sources. (MHR)

4134 (LA-5505-C, pp 147-156) COOLING BLACKBODY: A MECHANISM FOR COSMIC GAMMA-RAY BURSTS. Ramaty, R. (Goddard Space Flight Center, Greenbelt, MD); Cohen, J. M. Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

It is shown that blackbody radiation of variable temperature can account for the observed spectra of cosmic gamma-ray bursts. The temperature variation could be due to cooling by gamma-ray emission. For the model that is considered, an initial temperature of about 2×10^9°K decreases by a factor of about 3 during the observed duration of the bursts of about 2 seconds. Time integrated blackbody emission can then account for the observed spectrum in the gamma-ray region. When the temperature is further decreased, blackbody emission can also account for the x-ray observations. Possible sources for the gamma rays could be collapsing white dwarfs. This collapse could be caused by accretion which raises the mass above the Chandrashekhar limit. The gravitational energy released during the collapse causes the emission of neutrinos which heat the surface of the star to the desired temperature. The size of the radiating region is about 10^6 to 3×10^8 cm and its distance is between several tenths of megaparsecs to about 100 Mpc. The observed time variations are consistent with large amplitude oscillations of a white dwarf. (auth)

4135 (LA-5505-C, pp 157-165) HARWIT–SALPETER COMET MODEL. Shapiro, S. L. (Cornell Univ., Ithaca, NY). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

The infall of comets onto the surfaces of neutron stars as a mechanism for cosmic γ-ray bursts is discussed. (MHR)

4136 (LA-5505-C, pp 167-175) COSMIC GAMMA RAY BURSTS FROM STELLAR CORONAL STREAMERS. Brecher, K.; Morrison, P. (Massachusetts Inst. of Tech., Cambridge). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

It is suggested that the recently observed nonsolar gamma ray bursts arise in giant stellar coronal streamers. Directed beams of inverse Compton scattered photons could produce the observed time structure, spectrum and intensity of the events with a smaller energetic extrapolation than that required of thick target bremsstrahlung radiation directly analogous to solar x-ray bursts. (auth)

4137 (LA-5505-C, pp 176-185) COSMIC SOFT GAMMA-RAY BURSTS AND THE STELLAR SUPER-FLARE HYPOTHESIS. Stecker, F. W.; Frost, K. J. (Goddard Space Flight Center, Greenbelt, MD). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

It is proposed that the observed bursts do not originate in supernovae, and that alternative possibilities for the origin of these bursts should be explored. Here, the alternative possibility is discussed that these outbursts are simply giant versions of the x-ray bursts typically seen in solar flares. (MHR)

4138 (LA-5505-C, pp 192-203) SOFT GAMMA-RAY BURSTS FROM ACCRETING COMPACT OBJECTS. Lamb, D. Q.; Lamb, F. K.; Pines, D. (Univ. of Illinois, Urbana). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

The possibility is considered that the gamma-ray bursts may originate from fleeting episodes of accretion onto compact galactic objects. First, the characteristics of the observations which make this general class of models an attractive one is described and then a particular example is discussed which appears promising namely the triggering of bursts by solar-type flares in a binary companion. (MHR)

4139 (LA-5505-C, pp 237-249) HEAO-A SATELLITE AND ITS CAPABILITIES TO STUDY THE COSMIC γ-RAY BURSTS. Matteson, J. L. (Univ. of California, San Diego, La Jolla). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

The HEAO-A satellite and instruments are described. The capabilities of two of the instruments to study cosmic γ-ray bursts are discussed in detail. It is shown that, depending on the locations of the γ-ray bursts detected in other experiments, approximately 1600 (extragalactic origin) or 60 (galactic origin) γ-ray bursts should be detected. Of these, approximately 90 (extragalactic origin) or 2 (galactic origin) should have their position determined to an accuracy of $\lesssim$1 arc minute. (auth)

4140 (LA-5505-C, pp 262-277) PROPOSED GAMMA-RAY ASTRONOMY EXPERIMENT. Conner, J. P. (Los Alamos Scientific Lab., NM); Evans, W. D.; Higbie, P. R.; Klebesadel, R. W.; Olson, R. A.; Strong, I. B.; Spalding, R. E. Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

The Los Alamos Scientific Laboratory (LASL) and the Sandia Laboratories (SL) propose to develop and construct new satellite instrumentation to make observations on gamma-ray events of the type reported by Kelbesadel et al. (1973) while the Vela satellite system is still functional. Hopefully, the launch could take place within 12 to 18 months on a NASA Small Scientific Satellite or something similar. The new instruments would have very good capability for measuring the temporal and spectral characteristics of the signals, and the Vela satellite system would be used to distinguish real events from spurious glitches and for directional information. (auth)

4141 (LA-5505-C, pp 278-289) EXPERIMENTS FOR THE STUDY OF COSMIC GAMMA-RAY BURSTS. Cline, T. L.; Desai, U. D. (Goddard Space Flight Center, Greenbelt, MD). Feb 1974.

From conference on transient cosmic gamma- and x-ray sources; Los Alamos, New Mexico, USA (20 Sep 1973).

In proceedings of conference on transient cosmic gamma- and x-ray sources.

Several experiments are outlined which are designed for investigating cosmic gamma-ray bursts; they form a research program that includes balloon experiments currently under development and satellite experiments proposed for future missions. (MHR)

4142 (N-74-18421) DISTRIBUTION OF COSMIC RAYS IN THE GALAXY AND THEIR DYNAMICS AS DEDUCED FROM RECENT GAMMA-RAY OBSERVATIONS. Puget, J. L.; Stecker, F. W. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jan 1974. 32p. (NASA-TM-X-70597; X-640-74-17). NTIS $4.75.

Recent data from SAS-2 on the galactic gamma ray line flux as a function of longitude reveal a broad maximum in the gamma ray intensity in the region absolute value of 1 approximately smaller than 30°. These data imply that the low energy galactic cosmic ray flux varies with galactocentric distance and is about an order of magnitude higher than the local value in a toroidal region between 4 and 5 kpc from the galactic center. This enhancement can be plausibly accounted for by first order Fermi acceleration, compression and trapping of cosmic rays consistent with present ideas of galactic dynamics and galactic structure theory. Calculations indicate that cosmic rays in the 4 to 5 kpc region are trapped and accelerated over a mean time of the order of a few million years or about 2 to 4 times the assumed trapping time in the solar region of the galaxy. (auth)

4143 (N-74-19423) PRIMARY GAMMA RAYS. Fichtel, C. E. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Feb 1974. 37p. (NASA-TM-X-70612; X-662-74-57). NTIS $5.00.

Within this galaxy, cosmic rays reveal their presence in interstellar space and probably in source regions by their interactions with interstellar matter which lead to gamma rays with a very characteristic energy spectrum. From the study of the intensity of the high energy gamma radiation as a function of galactic longitude, it is already clear that cosmic rays are almost certainly not uniformly distributed in the galaxy and are not concentrated in the center of the galaxy. The galactic cosmic rays appear to be tied to galactic structural features, presumably by the galactic magnetic fields which are in turn held by the matter in the arm segments and the clouds. On the extragalactic scale, it is now possible to say that cosmic rays are not universal at the density seen near the earth. The diffuse celestial gamma ray spectrum that is observed presents the interesting possibility of cosmological studies and possible evidence for a residual universal cosmic ray density, which is much lower than the present galactic cosmic ray density. (auth)

4144 (N-74-21412) CHARGE COMPOSITION OF HIGH ENERGY HEAVY PRIMARY COSMIC RAY NUCLEI. Price, R. D. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Mar 1974. 175p. (NASA-TM-X-70622; X-661-74-71). NTIS $11.75.

Thesis.

A detailed study of the charge composition of primary cosmic radiation for about 5000 charged nuclei from neon to iron with energies greater than 1.16 GeV/nucleon is presented. Values are obtained after corrections were made for detector dependences, atmospheric attenuation, and solar modulation. New values of 38.5, 32.4, 23.7, and 16.8 g/cm^2 for the attenuation mean free paths in air for the same charge groups are presented. (auth)

4145 COMPOSITION OF COSMIC RAYS WITH $Z \geq 12$. Maehl, R. C. St. Louis; Washington Univ. (1974). 261p. University Microfilms Order No. 74-22,535.

Thesis (Ph.D.).

Cosmic ray results are reported from two high altitude balloon flights of a large area (0.9 m^2 ster), electronic primary cosmic ray detector. A detector consisting of fast pulse-type ionization chambers, a Lucite Cerenkov counter and scintillation hodoscopes to measure the charge, energy and isotopic composition of cosmic rays with $Z \geq 12$ were flown. A charge composition, consistent with other workers, over-abundant in the heavier elements with respect to the solar system was found. Using a leaky box propagation model, which implies an exponential path length distribution, it was inferred from the data that for $12 \leq Z \leq 26$ the cosmic ray source is composed of Mg, Si, S, Ca, and Fe in the ratio 0.98: 0.97: 0.175: 0.145: 1.00. While there may be trace amounts of some of the other elements, this composition adequately accounts for the observations. Also differences in the energy spectra of Fe from the other, lighter nuclei (specifically Si) in the 600 MeV/N $\leq T \leq$ 1600 MeV/N range are reported. These data are among the first observations of such differences. Specifically the Fe/Si ratio was found to be energy dependent, varying by 50% between 600 and 1200 MeV/N. The shapes of the two spectra are qualitatively different. The Fe is best fit by an exponential energy (or momentum) dependence while the Si is best fit by a power law in energy (or momentum). The results are especially interesting in light of recent observations by other workers of differences in the Fe and MH energy spectra at high energies. The isotope results are derived by using the geomagnetic field as a cosmic ray mass analyzer. These data are among the first on the isotopic composition in the $12 < Z < 26$ range, the mean isotopic composition for the cosmic ray source was found to be consistent with the mean isotopic composition of the solar system. In addition, observations of the charge composition and energy spectrum of the VVH component of the cosmic rays with $30 < Z < 45$ are reported. From the VVH data an r-process origin for the $30 < Z < 45$ charge group is inferred. Furthermore, the VVH energy spectrum was found to be consistent with the Fe energy spectrum and not with the Si. If a different source for the Fe, based on the differences in energy spectra is postulated, it would then appear that the $30 < Z < 45$ group is due to the Fe source, not the source of the lower-Z cosmic rays. (Diss. Abstr. Int., B)

4146 POWER SPECTRUM ANALYSIS OF COSMIC-RAY FLUCTUATIONS. I. The Bias Due to Data Averaging. Attolini, M. R. (CNR, Bologna); Cecchini, S.; Guidi, I.; Galli, M. Lett. Nuovo Cim.; 11: No. 7, 377-385(19 Oct 1974).

For analyzing cosmic-ray fluctuations, the systematic error on the power spectral density introduced by certain operations is shown, and it is indicated how to control or eliminate this error if some information on the general behavior of the unbiased spectrum is known. (JFP)

4147 POWER SPECTRUM ANALYSIS OF COSMIC-RAY FLUCTUATIONS. II. The Measurement Error Effort. Attolini, M. R. (CNR, Bologna); Cecchini, S.; Guidi, I.; Galli, M. Lett. Nuovo Cim.; 11: No. 7, 386-390(19 Oct 1974).

An analysis is made of how the Poissonian fluctuation and also any other measurement error may contribute to the power spectrum density for cosmic ray fluctuations. Ways are suggested to eliminate their effects. (JFP)

4148 POWER SPECTRUM ANALYSIS OF COSMIC-RAY FLUCTUATIONS. III. The Power Spectral Density in the Region (10^{-7} To 10^{-4}) Hz. Attolini, M. R. (CNR, Bologna); Cecchini, S.; Guidi, I.; Galli, M. Lett. Nuovo Cim.; 11: No. 7, 391-399(19 Oct 1974).

A way of eliminating many of the systematic errors generally overlooked in the power spectrum analysis of cosmic-ray fluctuations is found. It is shown how it is then possible to compute the power spectrum density of the cosmic ray intensity with a precision better than 10% over a time interval of one to two years, which would make possible the determination of its average variation during one single solar cycle. The results show a striking consistency and uniformity with respect to time, cut-off, asymptotic direction, and energy dependence. (JFP)

4149 CORRELATIONS OF PULSAR POSITIONS AND THE ARRIVAL DIRECTIONS OF AIR SHOWERS OF ENERGIES 10^{17} TO 10^{18} eV OBSERVED AT CHACALTAYA. Aquirre, C. (Univ. Mayor de San Andres, La Paz). J. Phys., A (London); 7: No. 12, 1474-1482(11 Aug 1974).

The arrival directions of 2598 air showers of energies between 10^{17} to 10^{18} eV observed at Mt Chacaltaya during 1964 to 1966 have been examined in order to search for a possible correlation with the known positions of pulsars. A plot of the declination against right ascension of the observed air showers has been divided into a grid of 5° declination against 5° right acension. A distribution of the number of showers along each declination band is then constructed. In each declination band those groups of showers (bins within the grid) which are above 2 standard deviations in the distribution are selected for further analysis. There are 36 such groups and among these, 19 coincide with the known positions of pulsars while 7.5 are expected from accidental coincidence. The results obtained from this preliminary analysis do not rule out the possibility that some at least of the cosmic ray primaries in the energy range studied originate in pulsars. (auth)

4150 COSMIC RAYS FROM GALACTIC AND EXTRAGALACTIC SOURCES. Strong, A. W.; Wdowczyk, J.; Wolfendale, A. W. (Univ. of Durham, Eng.). J. Phys., A (London); 7: No. 12, 1489-1496(11 Aug 1974).

A model is presented in which the bulk of the cosmic rays comprises two components: one, from galactic sources (probably pulsars), and the other having a universal, i.e., extragalactic, origin. Attention is directed particularly towards the particles above about 10^{17} eV which, like those below 10^{14} eV, are proposed to be of universal origin; it is shown that, if these particles have a production spectrum having constant exponent (differential value = -2.75), then interaction with the black-body radiation gives a spectrum at the earth not inconsistent with observation. In this model the extragalactic sources of cosmic rays do not increase in total number or in intensity at high red shifts. (auth)

4151 MUON UNDERGROUND COUPLING FUNCTIONS IN THE RANGE 20 TO 1000 hg. El Bedewi, F.; Goned, A.; Hindawi, S. (Ain Shams Univ., Cairo). J. Phys., A (London); 7: No. 12, 1483-1488(11 Aug 1974).

The coupling functions for underground cosmic ray muon component variations have been calculated by applying the CKP interaction model and allowing for the effect of muon energy loss fluctuations. For that purpose, the survival probabilities of muons have been calculated for standard rock for the range of depth 20 to 1000 hg and sea level energies 3.8 to 3000 GeV by using a Monte Carlo method. The average effect of range fluctuations was found to reduce the coupling functions by a factor between 0.96 and 0.45 over the range of depths considered. At a depth of 60 hg, the influence of such fluctuations on the diurnal variation in the muon component was found to decrease the amplitude by 0.34% and to increase the phase by 0.26%. (auth)

4152 SURFACE HISTORY OF SOME APOLLO 17 LUNAR SOILS. Fleischer, R. L.; Hart, H. R. Jr. (General Electric Co., Schenectady, NY). Geochim. Cosmochim. Acta; 38: No. 10, 1615-1623(Oct 1974).

Cosmic ray track densities in Apollo 17 soil samples are used to infer surface exposure times of soils from a trench at Van Serg Crater, from on and near a boulder at Camelot Crater, and from the position of the heat flow and neutron flux experiments (the ALSEP site). The topmost 2 cm of soil at Van Serg was exposed for 11 m.y., the top cm at Camelot, for 36 m.y. A layering chronology and average deposition rate are proposed for the trench. For all soils the median track densities imply predispositional irradiation in the top 15 cm of the lunar surface for times that were long compared with the actual residence in the stratigraphic positions from which the soils were collected. Van Serg crater is inferred to have been formed approximately 24 m.y. ago. (auth)

4153 COSMIC-RAY EXPOSURE HISTORY AT THE APOLLO 16 AND OTHER LUNAR SITES. Lunar Surface Dynamics. Drozd, R. J.; Hohenberg, C. M.; Morgan, C. J.; Ralston, C. E. (Washington Univ., St. Louis). Geochim. Cosmochim. Acta; 38: No. 10, 1625-1642(Oct 1974).

Concordant ^{81}Kr–Kr exposure ages for four station 11 breccias indicate an age of 50.3 ± 0.8 m.y. for North Ray Crater. Ray structures visible from orbital photography suggest that stations 8 and 9 should contain a substantial amount of South Ray ejecta.

Concordant ^{81}Kr–Kr exposure ages at these sites indicate an age for South Ray Crater of 2.04 ± 0.08 m.y. Surface effects (tracks, surface angularities, and micro-crater populations) show good general agreement with this young age, but discrepancies on a sample-by-sample basis seem to indicate that extensive pre-surface irradiations must have occurred. A detailed pre-surface exposure history is derived for the parent boulder of samples 69935 and 69955. It is suggested that secondary impacts play a major role in near-surface regolithic stirring. Widespread pre-surface irradiation would in fact be expected if most of the newly excavated material had been transported to the surface by secondary impacts rather than by the South Ray event itself. (auth)

4154 MODULATION OF COSMIC RAY PROTONS AND HELIUM NUCLEI NEAR SOLAR MAXIMUM. Rygg, T.A.; O'Gallagher, J.J.; Earl, J.A. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). J. Geophys. Res. 79: No. 28, 4127-4137 (1 Oct 1974).

Balloon observations of proton and helium spectra in 1970, 1971, and 1972, which extend previous work for the period 1965–1969, reveal a factor of ~1.85 deviation from a single–valued regression at low rigidities. This deviation decreases with increasing rigidity for both species. The period 1969–1970 is unique because time variations at low and high energies were anticorrelated. When satellite observations are used to extend the balloon observations to energies below 100 MeV/nucleon, the proton spectrum shows a steeper slope in 1970 and 1972 than the characteristic J=AT spectrum observed during 1965–1969. The slope of the helium spectrum became continuously flatter during the same period (1970–1972). Computer–generated spectra based on simple two–parameter modulation models describe the basic features of the observations if one of the variable parameters is used to characterize the rigidity dependence of the diffusion coefficient. On the other hand, models that do not allow such a variation are not consistent with the observations. (auth)

4155 COSMIC RAY STREAMING PERPENDICULAR TO THE MEAN MAGNETIC FIELD. Forman, M.A. (Department of Earth and Space Science, State University of New York at Stony Brook); Jokipii, J.R.; Owens, A.J. Astrophys. J. 192: No. 2, 535-540 (1 Sept 1974).

Starting from a quasi–linear approximation for the ensemble–averaged particle distribution function in a random magnetic field, we derive the complete diffusion tensor. This is done by assuming a simple form $(vU+3S{\cdot}v/v)/4\pi p^2$ for the ensemble–averaged distribution function, explicitly retaining all components of the streaming flux S. To terms of order $\langle \delta B^2\rangle/B^2$ the previously discussed diffusion tensor is regained. This derivation obtains the antisymmetric terms in a natural manner. The necessary dropping of higher–order terms gives a criterion for the lower–energy limit of validity of the perpendicular and antisymmetric diffusion coefficients. The limit for the assumed distribution function is about 0.8 GV rigidity in the interplanetary field near 1. a.u. The perpendicular diffusion coefficient $\kappa_\perp \simeq 4\times 10^{20}\beta$ cm^2 s^{-1}, and $\kappa_\perp/\kappa_\parallel \sim 0.07$ at 1 GV rigidity. This is a factor 5 smaller than perviously given, because of a reevaluation of numerical factors. (auth)

4156 ELECTROMAGNETIC SCATTERING FROM A BLACK HOLE AND THE GLORY EFFECT. Mashhoon, B. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 10: No. 4, 1059-1063 (15 Aug 1974).

The scattering of electromagnetic radiation by a black hole is discussed and further results on this problem are presented. It is shown that the backward glory effect is absent in the Schwarzschild field as well as in the Kerr case when plane electromagnetic waves are incident along the axis of symmetry of the field. A cosmological distribution of Kerr black holes could result in the polarization of the cosmic background radiation for which a crude estimate is given. (auth)

4157 ABSOLUTE SEA-LEVEL INTEGRAL MUON SPECTRA AT ZENITH ANGLES 45 AND 60°W NEAR THE GEOMAGNETIC EQUATOR IN THE MOMENTUM RANGE (0.4 TO 3) GeV/c. Bhattacharyya, D. (Indian Association for the Cultivation of Science, Calcutta). Nuovo Cim., 24B: No. 1, 78-84(11 Nov 1974).

The absolute integral sea-level spectra of single muons at zenith angles $\theta = 45$ and 60°W were estimated by means of a range spectrograph near the geomagnetic equator (12°N) in the muon momentum range (0.4 to 3) GeV/c. The measured spectra after corrections, when compared to the vertical integral spectrum, follow the cosine law $I(\theta) = I(0) \cos^n\theta$. The average value of $n = 1.85 \pm 0.10$ is in accordance with the results of Sreekantan et al., Judge and Nash, and Crookes and Rastin. The experimental spectra agree well with the theoretical spectra calculated after Barrett et al. (auth)

4158 INVESTIGATION OF THE EFFECT OF THE ATMOSPHERE ON COSMIC-RAY INTENSITY BY MULTIFACTOR REGRESSION ANALYSIS WITH RESPECT TO THE PRINCIPAL COMPONENTS. Akhababyan, N.; Nedyalkova, M.; Yakova, E. (Inst. of Nuclear Research and Nuclear Power Engineering, Sofia). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 13-18(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 18-24(1974).

A mathematical-statistical analysis is performed of the effect of the atmosphere on the intensity of different cosmic-ray components recorded simultaneously at Musala City (Bulgaria). It is demonstrated that as long as the use of normal regression analysis leads to a good approximation, but to ambiguous results because of correlations between the parameters forming the factor space, application of multifactor regression analysis with respect to the principal components permits determining the independent effects of individual meteorological parameters. (auth)

4159 POSITRON ANNIHILATION IN EAS AND BALL LIGHTNING. Cecchini, S.; Di Cocco, G.; Mandolesi, N. (Consiglio Nacionale delle Ricerche, Bologna). Nature (London); 250: No. 5468, 637-638(23 Aug 1974).

Reference is made to Crawford (Nature 239:395(1972)), who suggested that observed bursts of γ-radiation corresponding to positron annihilation at 0.511 MeV may be caused by extensive air showers of primary energy about 10^{16} eV. Two major objections to this hypothesis are made, on the basis of the duration of the γ-ray bursts and delays in the distribution of the various EAS components. The high number of photons claimed to be created is also queried. (UK)

4160 RELEVANCE OF COSMIC GAMMA-RAYS TO ORIGIN OF THE COSMIC RADIATION. Dodds, D.; Strong, A. W.; Wolfendale, A. W. (Univ. of Durham, Eng.). Nature (London); 250: No. 5469, 716-717(30 Aug 1974).

It is stated that the observation of cosmic γ-rays has given hope for a distinction between the Galactic and extragalactic models for the production of energetic cosmic rays, or at least for cosmic ray protons of energy 1 GeV < E < 10 GeV, whose collisions with interstellar gas atoms are considered to give rise to the π^0 mesons from which the γ-rays are derived. Experimental data indicate that there is an increase in γ-ray emissivity towards the Galactic center, with a peak at a radial distance of about 5 kpc. In models so far proposed it is assumed that the predominant interaction responsible for the parent π^0 mesons is that between cosmic ray protons and protons from neutral H atoms. Correlations of γ-ray emissivity with giant H regions are discussed. New results indicate that the cosmic ray flux is more consistent with a largely extragalactic origin of cosmic rays rather than with a galactic origin. (UK)

Stars

Refer also to abstracts 4135, 4296, 4329, 4336, 4343, 4348, 4450, 4461, 5008, and 5129.

4161 (N-74-21435) INVESTIGATION OF ULTRAVIOLET FLUXES OF NORMAL AND PECULIAR STARS. Final Report. Deutschman, W. A.; Schild, R. E. (Smithsonian Astrophysical Observatory, Cambridge, Mass. (USA)). Apr 1974. 42p. (NASA-CR-137411). NTIS $5.25.

Data from Project Celescope, a program that photographed the ultraviolet sky, in order to study several problems in current astrophysics are analyzed. Two star clusters, the Pleiades and Hyades, reveal differences between the two that we are unable to explain simply from their differences in chemical abundance, rotation, or reddening. Data for Orion show large scatter, which appears to be in the sense that the Orion stars are too faint for their ground-based photometry. Similarly, many supergiants in the association Sco OB1 are too faint in the ultraviolet, but the ultraviolet brightness appears to be only poorly correlated with spectral type. Ultraviolet Celescope data for several groups of peculiar stars have also been analyzed. The strong He I stars are too faint in the ultraviolet, possibly owing to enhancement of O II continuous opacity due to oxygen overabundance. The Be stars appear to have ultraviolet colors normal for their MK spectral types. The P Cygni stars are considerably fainter than main-sequence stars of comparable spectral type, probably owing, at least in part, to line blocking by resonance lines of multiply ionized light metals. The Wolf–Rayet stars have ultraviolet color temperatures of O stars. (auth)

4162 (N-74-23365) STELLAR WINDS DRIVEN BY ALFVEN WAVES. Belcher, J. W.; Olbert, S. (Massachusetts Inst. of Tech., Cambridge (USA). Center for Space Research). Oct 1973. 85p. (NASA-CR-138244; CSR-TR-73-5). NTIS $7.25.

Models of stellar winds were considered in which the dynamic expansion of a corona is driven by Alfven waves propagating outward along radial magnetic field lines. In the presence of Alfven waves, a coronal expansion can exist for a broad range of reference conditions which would, in the absence of waves, lead to static configurations. Wind models in which the acceleration mechanism is due to Alfven waves alone and exhibit lower mass fluxes and higher energies per particle are compared to wind models in which the acceleration is due to thermal processes. For example, winds driven by Alfven waves exhibit streaming velocities at infinity which may vary between the escape velocity at the coronal base and the geometrical mean of the escape velocity and the speed of light. Upper and lower limits were derived for the allowed energy fluxes and mass fluxes associated with these winds. (auth)

4163 ABUNDANCE ANALYSIS OF PRZYBYLSKI'S STAR (HD 101605). Wegner, G.; Petford, A. D. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 557-575(Sep 1974).

The spectrum of Przybylski's star (Hd 101065), which is completely dominated by lines of the rare earths, was studied using spectra in the red. From this material, all observed lines were measured for wavelengths and identifications, attempted. From the resulting list of apparently unblended lines, a curve of growth analysis of the star was carried out. This analysis confirms Przybylski's result that very high overabundances of the rare earths by five orders of magnitude compared to cosmic abundances exist when allowance is made for the difference in adopted atmospheric parameters in the two studies. Also, the presence of previously unreported elements of the iron-peak and lighter elements is established, and their abundances are found to be closer to normal with respect to the Sun if the star's hydrogen abundance is assumed to be normal. From the derived value of the excitation temperature from the curve of growth ($T_{exc} = 6267 \pm 120$ K) and Balmer line strengths, the star is probably a dwarf of spectral class Fop. This seems consistent with the kinematical properties of the star, which place it in the young disk population. The abilities of some current theories to explain the abundance anomalies are briefly discussed, and a few suggestions for future study are given. (auth)

4164 ADIABATIC STABILITY OF STARS CONTAINING MAGNETIC FIELDS. III. Additional Results for Poloidal Fields. Markey, P.; Tayler, R. J. (Univ. of Sussex, Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 505-514(Sep 1974).

In a previous paper (Markey et al., Mon. Not. R. Astr. Soc.; 163: 77 (1973)) it has been shown that a particular poloidal magnetic field configuration, with closed magnetic field lines inside a star, is unstable and that the instabilities grow in a short time compared with time scales important in stellar evolution. In that paper it was suggested that the results obtained depended only on the field topology and not on its precise structure. In the present paper three further types of poloidal field configuration are studied, and they are all shown to be unstable. It thus appears very probable that all poloidal configurations with closed field lines are unstable. (auth)

4165 EVOLUTION OF VISCOUS DISCS AND THE ORIGIN OF THE NEBULAR VARIABLES. Lynden-Ball, D.; Pringle, J. E. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 603-637(Sep 1974).

The evolution of discs under the action of viscosity is studied by both similarity solutions and Green's functions. The angular momentum is steadily concentrated onto a small fraction of the mass which orbits at greater and greater radii while the rest is accreted onto the central body. It is assumed that the angular momentum excess of a proto-star is initially concentrated onto one-third of the total mass which forms a disc orbiting the newborn star. Viscous dissipation in the disc will cause it to shine with a luminosity greater than the final main sequence star for a period of 10^5 yr or so. Most of the properties of T Tauri stars can be explained as a consequence of disc evolution. Flares in Flare stars are interpreted as the entry of blobs of an old disc into the late type stellar atmospheres. On this hypothesis flaring activity could be observed in M stars of up to 5×10^8 yr old, and planetary systems will be common. Disc solutions appropriate to dwarf novae and X-ray sources are also given. (auth)

4166 PROBABLE SYMBIOTIC AND VV CEPHEI STARS IN THE MAGELLANIC CLOUDS. Feast, M. W. (Radcliffe Observatory, Pretoria); Webster, B. L. Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 31P-35P(Sep 1974).

The spectra of five stars in the Large Magellanic Cloud are described. Two of these are considered to be probable symbolic stars, and two are probable VV Cephei systems. A possible VV Cephei system in the Small Magellanic Cloud is mentioned. Estimates of the absolute magnitudes of the cool components are M_v fainter than -3.4 and -1.5 for the two symbiotic stars and M_v about -7 in the case of the two VV Cephei systems in the Large Cloud. (auth)

4167 STELLAR ATMOSPHERES AND LABORATORY ASTROPHYSICS. Presidential Address. Blackwell, D. E. (Oxford Univ.). Quart. J. Roy. Astron. Soc.; 15: No. 3, 224-245 (Sep 1974).

The measurement of stellar abundances, particularly of solar abundances, is reviewed, and some of the uncertainties and inaccuracies are considered in detail. It is pointed out that, in spite of many advances in the techniques used for measurement of spectra and methods of interpretation, there is still a large spread of abundance values. It is stated that the abundance of an element in a star is obtained from measurements of the equivalent widths of absorption lines in the spectrum, which depend on the atmospheric model employed and the atomic parameters for the element: all aspects of the subject are then reviewed. The major part of the address deals with atomic parameters: it is stated that the principal information needed is the variation of atomic absorption coefficient, at each depth in the atmosphere, over the wavelength range of the observed line profile. This is determined cheifly by the oscillator strength of the transition, together with the broadening due to the thermal Doppler effect and to any 'microturbulence', and to damping. This spread in the atomic absorption coefficient then determines the absorption line profile. The significance of 'microturbulence' and the damping on the equivalent width of a line are considered. The importance of a low noise spectrum is demonstrated, with a figure showing the effect of integration, for increasing periods, on the signal/noise ratio in a part of the solar spectrum. Detailed consideration is given to the measurement of oscillator strengths. The relation between astrophysical measurements and laboratory measurements is discussed. (UK)

4168 RAPID LINE VARIABILITY. I. Ap STARS EPSILON URSAE MAJORIS AND 73 DRACONIS. Breger, M. (University of Texas at Austin and McDonald Observatory). Astrophys. J. 192: No. 1, 71-74 (15 Aug 1974).

Because of various reports in the literature about rapid variations of hydrogen and calcium lines in these two Ap stars, about 500 photoelectric hydrogen and calcium profiles have been obtained with high time resolution. No line—profile or equivalent—width variations beyond the expected errors could be found. In fact, for ϵ UMA, a very bright star, the Hα equivalent widths were constant to 0.2 percent during the time of observation. (auth)

4169 CALIBRATIONS AND APPLICATIONS OF THE uvby PHOTOMETRIC SYSTEM. Breger, M. (University of Texas at Austin and McDonald Observatory). Astrophys. J. 192: No. 1, 75-80 (15 Aug 1974).

For Population I A and F stars, the c_1 and $(b-y)$ indices are calibrated in terms of T_{eff} and log g by the use of ATLAS model atmospheres. The resultant calibration is in excellent agreement with independent information on temperatures and gravities. The various absolute magnitude calibrations of the uvby system in the literature are compared by applying them to several close open clusters. Systematic errors may be present in older calibrations and no one calibration can fit all the clusters of different abundances. The excellent recent β, c_1 calibration by Crawford is extended to $(b-y)$, c_1. A comparison of continuum scans and published uvby photometry for 159 B, A, and F stars show that the observed $(u-b)$ and $(b-y)$ colors can be predicted successfully from continuum scans to a precision of 0.015 and 0.012 mag. For ordinary B, A, and F stars, T_{eff} and log g can be deduced more quickly and accurately from uvbyβ photometry than from continuum scans. (auth)

4170 THE BETA CEPHEI NATURE OF SPICA. Dukes, R.J. Jr. (Steward Observatory, University of Arizona). Astrophys. J. 192: No. 1, 81-91 (15 Aug 1974).

We have obtained 722 new velocities of the primary component of Spica (α Vir) during the 1970 and 1971 observing seasons, as well as 10 nights of spectral scans of the He 4471 line. The new measures were combined with published velocities to determine an improved orbit which has a significantly lower K_1 than that found in earlier work. The residuals of these velocities from the orbit were analyzed for the pulsational phenomenon. We found that, in addition to the known pulsational frequency ($f_1 = 5.7542$ c/d), there are three previously undetected frequencies ($f_2=5.7854$ c/d, $f_3=4.1158$ c/d, and $f_4=3.6171$ c/d). The existence of these new terms was verified by the presence of similar terms in the previously published photometric data. We also found a correlation between the pulsation amplitude and the tidal potential at the surface of the primary. Comparison of the observational results with pulsation models showed best agreement for the strongest frequency as the radial first overtone mode. The additional frequencies were identified as the weakly excited fundamental (f_3) and two nonradial modes. (auth)

4171 STELLAR MODEL CHROMOSPHERES. II. PROCYON (F5 IV—V). Ayres, T.R.; Linsky, J.L.; Shine, R.A. (Joint Institute for

Laboratory Astrophysics, University of Colorado). Astrophys. J. 192: No. 1, 93-107 (15 Aug 1974).

We derive a model for the chromosphere and upper photosphere of Procyon (F5 IV–V) based on calibrated observations of the K and 8542 Å lines of Ca II, the k(2796 Å) line of Mg II, and the K–line wings. We demonstrate the feasibility of our model synthesis approach to derive a preliminary model chromosphere despite the lack of spatial and spectral resolution associated with solar chromospheric studies. Our upper photosphere model is very similar to the radiative equilibrium Procyon model of Strom and Kurucz, and our chromospheric model is similar to the quiet solar chromosphere temperature distribution of Shine in the $6000^\circ-8000^\circ$ K range. (auth)

4172 ANGULAR DIAMETER OF IRC+10011 AT 2.2, 10, AND 20 MICRONS. Zappala, R.R. (Hale Observatories, Carnegie Institution of Washington,); Becklin, E.E.; Matthews, K.; Neugebauer, G. Astrophys. J. 192: No. 1, 109-112 (15 Aug 1974).

The size of the long–period variable IRC+10011 at 2.2, 10, and 20 μ has been measured by means of lunar occultations. At 10 and 20 μ the bulk of the radiation comes from the optically thick dust region about $0\overset{''}{.}1$ in diameter. At 2.2 μ the dominant source of radiation is the central Mira star, but the inner part of the dust shell is also visible. (auth)

4173 NEAR–INFRARED PHOTOMETRY OF UNIDENTIFIED IRC STARS. II. Lockwood, G.W. (Kitt Peak National Observatory). Astrophys. J. 192: No. 1, 113-132 (15 Aug 1974).

Near–infrared and visual photometry at 7 wavelengths including a continuum point at 1.04 μ is given for 83 IRC stars. Colors and photometric spectral types derived from molecular band indices permit further classification of the stars into M giants, M supergiants, and carbon stars as well as comparison with normal brighter stars of the same types. Most of the giants and carbon stars vary strongly at V and 1.04 μ and are probably Mira variables. The M supergiants, which are heavily reddened (mean $A_v \simeq 6.8$ mag), are nearly all nonvariable. (auth)

4174 AN ANALYSIS OF THE CH STAR HD 198269. Lee, P. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge). Astrophys. J. 192: No. 1, 133-138 (15 Aug 1974).

A differential curve–of–growth analysis of the CH star HD 198269 is described. The star ϵ Vir is used as a comparison. Atmospheric parameters are determined to be: $\theta=1.125$, $[Fe/H]=-1.56$, $[C/Fe]=1.92$. These results are compared with analyses of similar stars. (auth)

4175 THE CALCULATION OF PERIODIC PULSATIONS OF STELLAR MODELS. Stellingwerf, R.F. (Joint Institute for Laboratory Astrophysics, University of Colorado). Astrophys. J. 192: No. 1, 139-144 (15 Aug 1974).

A new relaxation technique for the calculation of exact periodic solutions of the nonlinear radial pulsation problem is presented. This method is more economical than the usual approach and also allows direct computation of the stability of each mode. It is expected that these techniques could be incorporated easily into existing nonlinear programs. An example of the application of this technique is given as well as the technical details needed for its use. (auth)

4176 INFLUENCE OF ROTATION ON THE MAXIMUM MASS OF PULSATIONALLY STABLE STARS. Stothers, R. (Institute for Space Studies, Goddard Space Flight Center, NASA, New York, New York). Astrophys. J. 192: No. 1, 145-148 (15 Aug 1974).

The critical mass for stability against radial pulsations in rotating, homogeneous main–sequence stars is found to be greater than in the case of no rotation. Analytic and detailed numerical models show that the critical mass rises steeply with increasing concentration of angular momentum to the center of the star. For uniform rotation near breakup velocity at the star's equator the critical mass is $\sim 850\ M_\odot$ if an electron–scattering opacity is used, or $\sim 5000\ M_\odot$ if the opacities of Cox and Stewart are used. For nonuniform rotation with a constant ratio of centrifugal force to gravity in the star, the critical mass becomes "infinite" long before breakup velocity is attained. The relevance of the present results to several observational problems is noted. (auth)

4177 STARSPOTS ON FLARE STARS. Mullan, D.J. (Bartol Research Foundation of The Franklin Institute, Swarthmore, Pennsylvania). Astrophys. J. 192: No. 1, 149-157 (15 Aug 1974).

Sizes of starspots on flare stars can be derived from the author's convection–cell hypothesis. The sizes are in fair agreement with those observed on YY Gem, CC Eri, and BY Dra by Bopp and Evans. The hypothesis predicts that periodic brightness variations due to starspots are restricted to stars brighter than a critical absolute visual magnitude. A convective model of a starspot on YY Gem has been computed, assuming that the missing flux is in the form of Alfvén waves. It is found that the surface field must exceed 10^4 gauss, and is probably less than about 3×10^4 gauss. With a surface field of 2×10^4 gauss, the effective temperature of the spot is in the range $T_e=1590^\circ-1890^\circ$ K, depending on the field gradient. These figures are to be compared with $T_e=2000^\circ$ K estimated from observations by Bopp and Evans. Efficient dynamo action is shown to be a possible mechanism for generating such large surface fields. There is a possibility that tidal effects may influence starspot formation. (auth)

4178 SPECTROPHOTOMETRIC STUDIES OF GASEOUS NEBULAE. XXIII. THE PLANETARY NEBULA NGC 6803. Lee, P. (Department of Physics and Astronomy, Louisiana State University); Aller, L.H.; Kaler, J.B.; Czyzak, S.J. Astrophys. J. 192: No. 1, 159-163 (15 Aug 1974).

We have measured line intensities between $\lambda\lambda$3299 and 5007, as well as the [Cl III] λ5537/λ5517 and the [S II] λ6731/λ6716 ratios, by a combination of photographic and photoelectric techniques. The electron density of the nebulae increases strongly toward the center. There appears to be a small but definite excess of helium. (auth)

4179 RADIO–CONTINUUM MEASUREMENTS OF PLANETARY NEBULAE AT 15.5 GHz. Sistla, G. (State University of New York at Albany); Kojoian, G.; Chaisson, E.J. Astrophys. J. 192: No. 1, 165-168 (15 Aug 1974).

We have accurately observed 17 planetary nebulae at the reasonably high microwave frequency of 15.5 GHz. Estimates of interstellar extinction derived from measurements of flux density compare favorably with those evaluated from a dust model of the Galaxy and with those derived from the intensity ratio of Paschen and Balmer lines of hydrogen. The ionic abundance ratio O^{++}/H^+ is obtained by a new technique and is consistent with values found by other methods. (auth)

4180 ELECTRONIC TRANSITIONS OF THE ZrO MOLECULE: TRIPLET SYSTEMS. Schoonveld, L.; Sundaram, S. (Department of Physics, University of Illinois at Chicago Circle, Chicago, Illinois). Astrophys. J. 192: No. 1, 207-211 (15 Aug 1974).

In view of the renewed interest in the spectra of ZrO molecule, which is an important component of the atmospheres of S stars, a complete and systematic analysis of all available elecctronic spectral data has been made. The triplet systems $C^3\Delta-X{\cdot}3\Delta$, $B^3\Pi-X{\cdot}3\Delta$, and $A^3\Phi-X^{\cdot 3}\Delta$ have been analyzed and a consistent set of molecular constants have been calculated. Using Morse eigenfunctions, Franck–Condon factors and r–centroids have been obtained. RKR and Morse potential curves have been generated for all the four electronic states of ZrO molecule. (auth)

4181 RELATIVISTIC EJECTION OF A PARTICLE BY RADIATION PRESSURE. II. Noerdlinger, P.D. (Department of Astronomy and Astrophysics, Michigan State University, East Lansing). Astrophys. J. 192: No. 2, 529-533 (1 Sept 1974).

Previous investigation of the relativistic ejection of particles by radiation pressure is extended to consider the effect of a finite size source of radiation. A remarkable limiting Lorentz factor is found (as a function of distance from the source) beyond which no radiation field, however powerful, can accelerate the particle. For very strong sources, a considerable reduction in the terminal energy ensues if the source subtends a large angle at the particle, assuming equal initial acceleration. As an asymptotic limit for strong sources, the terminal energy of a particle released from rest at the source surface is proportional to the fourth root of the luminosity, while in the case of a point source the terminal energy is proportional to the cube root of the luminosity. (auth)

4182 s–PROCESS STUDIES: EXACT SOLUTION TO A CHAIN HAVING TWO DISTINCT CROSS–SECTION VALUES. Clayton, D.D.; Newman, M.J. (Department of Space Physics and Astronomy, Rice University). Astrophys. J. 192: No. 2, 501-505 (1 Sept 1974).

We present the exact solution to an s–process chain having two distinct values for the cross–sections. The comparison of this exact solution with the CFHZ approximate solution to the same problem reveals that approximate solution to be adequate for most astrophysical problems. (auth)

4183 STUDIES OF EVOLVED STARS. III. MODELS OF FG SAGITTAE CONSISTENT WITH s–PROCESS NUCLEOSYNTHESIS. Ulrich, R.K. (California Institute of Technology, Pasadena, California and Astronomy Department, University of California, Los Angeles). Astrophys. J. 192: No. 2, 507-516 (1 Sept 1974).

Models for the hydrogen–rich envelope of FG Sge show that for a range of temperature and luminosity compatible with the observations, the mass of the envelope must either be fairly small ($\sim 0.04\,\mathfrak{M}_\odot$) or moderately large ($5-7\,\mathfrak{M}_\odot$). Models with an envelope mass in between the two extremes require a degenerate core with mass in excess of the Chandrasekhar limit. Nucleosynthesis calculations show that the present envelope mass must be small. There are two possible models for the nucleosynthesis: (a) Matter in the region between the hydrogen and helium shell sources was irradiated by a weak neutron source over an extended period of time prior to the ejection of the planetary nebula surrounding FG Sge. Mixing to the stellar surface occurred only after the recent event which caused FG Sge to begin expansion. (b) About 18 protons were mixed into the intershell region for every ^{56}Fe nucleus already present in this region. Neutron irradiation due to the strong neutron source ^{12}C(p, γ)^{13}N(β^+)^{13}C(α, n)^{16}O occurred in a brief recent mixing episode. Both models can successfully account for the observed abundances, although the small change in the carbon abundance is difficult to account for in the weak—source model. An observational distinction between the two models may be possible from the Ga abundance. Should FG Sge become cool enough to show molecular lines in its spectra, a clear distinction between the models will be possible. The strong—source model with high intershell over—abundances of heavy elements would leave the isotope ratios of Ti and Si (observed in TiO and SiH) unaltered. The weak—source model on the other—hand, has much smaller intershell overabundances of heavy elements and requires the abundances (^{48}Ti, ^{49}Ti, ^{50}Ti) and (^{28}Si, ^{29}Si, ^{30}Si) to be changes from (1,0.075, 0.072) and (1,0.051, 0.034) to (1,0.094, 0.132) and (1,0.068, 0.064). (auth)

4184 INFRARED PHOTOMETRY OF WOLF—RAYET STARS FROM 2.3 TO 23 MICRONS. Hackwell, J.A.; Gehrz, R.D.; Smith, J.R. (Department of Physics and Astronomy, University of Wyoming, Laramie). Astrophys. J. 192: No. 2, 383-390 (1 Sept 1974).

Measurements have been made of 19 Wolf—Rayet stars in the 2.3—μ to spectral region. At 3.5 μ all but two of the stars studied have an infrared excess which increases at longer wavelengths. The data reveal no systematic difference between the WC and WN sequences. Four infrared emission mechanisms are discussed and free—free emission from a circumstellar plasma is shown to be the most probable source of the infrared radiation. Analysis of the photometric measurements gives a mean electron density for the shell of $N_e = 1 \times 10^{12}$ cm^{-3}, and a mean size of 3R$_*$. These parameters imply a mean mass loss rate for Wolf—Rayet stars of 1.6×10^{-5} M$_\odot$ d$_\odot$ yr^{-1}. (auth)

4185 FURTHER OBSERVATIONS OF STARS IN THE INTERMEDIATE—AGE OPEN CLUSTER NGC 2477. Hartwick, F.D.A. (University of Victoria); Hesser, J.E. Astrophys. J. 192: No. 2, 391-404 (1 Sept 1974).

Recent uvby—Hβ photometry of main—sequence stars in NGC 2477 has led to the following conclusions: (i) Confirmation of previously determined reddenings and V—band photometry. (ii) The surface gravities of the turnoff stars are similar to those of analogous Hyades stars. (iii) The existence of a discrepancy between [Fe/H] inferred from m$_1$ and CN measures that can be at least partially resolved if the cluster contains a large number of rapidly rotating stars (v sin i $\simeq$ 200 km s^{-1}). (iv) NGC 2477 appears to have a number of Am stars. (v) Three stars identified as possible "blue stragglers" have higher masses than stars near the turnoff point. (vi) The upward—revised turnoff point at V=13.3 mag (M$_V$=1.7) leads to an age and turnoff mass of 0.9×10^9 years and 1.9 $\mathfrak{M}_\odot$, respectively. Additional B, V photographic data for ~1,200 stars are presented and used to construct a new color—magnitude diagram based on ~1,900 stars to Mv ~+6.4 mag. Results of a survey that revealed two carbon stars in the near vicinity of the cluster are presented and compared with results for other intermediate—age clusters, and photoelectric photometry demonstrating the variability of the two stars is given. Finally, from a discussion of data in the literature we present evidence for a correlation between $\Delta\beta$ and v sin i in main—sequence A and F stars in the range $0.1 < (b-y)_0 < 0.25$ mag. (auth)

4186 TWO MIRA VARIABLES IN THE STELLAR SYSTEM TERZAN 5. Spinrad, H. (Astronomy Department, University of California, Berkeley); Smith, M.G.; Harlan, E. Astrophys. J. 192: No. 2, 405-407 (1 Sept 1974).

We report on near—infrared photometry of two Mira—type variable stars which are likely members of Terzan 5. The periods are 227^d and 245^d, slightly longer than those of the Miras found in the metal—rich globular cluster 47 Tucanae. (auth)

4187 HARMONIC ANALYSIS OF THE LINE PROFILES OF AN OBLIQUE ROTATOR. Falk, A.E.; Wehlau, W.H. (Department of Astronomy, University of Western Ontario). Astrophys. J. 192: No. 2, 409-415 (1 Sept 1974).

A method of determining the parameters of the oblique—rotator model from observed line profiles is presented. Advantages and disadvantages of this procedure compared with the harmonic analysis method described by Deutsch are discussed. To illustrate the method, analyses have been carried out on some lines in the spectrum of α^2 CVn. The results are discussed briefly. It appears that the method works, and should provide better results when more accurate data are available. (auth)

4188 THE STRUCTURE OF ALPHA VIRGINIS. II. THE APSIDAL CONSTANT. Odell, A.P. (Washburn Observatory, University of Wisconsin—Madison). Astrophys. J. 192: No. 2, 417-424 (1 Sept 1974).

The binary system Spica (α Vir) is analyzed by comparing theoretical models with the masses, radii, and fluxes of the components. The temperature is found from the total measured flux and the radius. It is found that the models computed under the usual physical assumptions are able to fit the present temperature and luminosity, but would need either an increased mass or an increased helium content. These models do not fit the apsidal constant in the sense that the models never become sufficiently centrally condensed, and the observed apsidal constant is too small by a factor of 2. Models with increased opacities have the same need for larger mass or helium content, but for these models the apsidal constant is consistent with the observed value. If the model star is assumed to have arbitrary (nonconvective) mixing to the boundary of the main—sequence convective region, both the photometric and apsidal predictions can be matched with Cox—Stewart opacities. The models show only three acceptable evolutionary stages: the end of core hydrogen burning, the overall contraction phase, or the beginning of the shell—burning stage. (auth)

4189 ULTRAVIOLET DETECTION OF THE DWARF NOVA SS CYGNI. Holm, A.V. (Space Astronomy Laboratory, Washburn Observatory, University of Wisconsin—Madison). Astrophys. J. 192: No. 2, 425-428 (1 Sept 1974).

The OAO—2 was used to obtain far—ultraviolet measurements of SS Cygni at maximum, at minimum, and during the rise to maximum. These data are combined with ground—based observations for a new discussion of interstellar extinction, effective temperature, distance, and luminosity for this sytstem. At maximum the effective temperature was found to be 19,200°±3000°K. The distance is estimated to be between 140 and 330 pc, with the corresponding limits to the luminosity being 40 and 360 L$_\odot$. A brief discussion of the relationship between dwarf novae, X—ray sources, and galactic novae is also presented. (auth)

4190 STEADY—STATE MASS LOSS FOR Be STARS. Limber, D.N. (Department of Astronomy, University of Virginia). Astrophys. J. 192: No. 2, 429-445 (1 Sept 1974).

A model for steady—state mass loss in the regions in and near the equatorial planes of Be stars is developed that includes the effects of forces resulting from gravitation, from pressure gradients, and from magnetic fields coupling isothermal circumstellar envelopes to the rapidly rotating bodies of the stars. For representative values for the different input parameters, steady—state solutions have been sought. The problem has been found to be an eigenvalue one that possesses a single physically acceptable solution for certain choices of all but one of the input parameters and no solution at all for other choices. The domain in which steady—state solutions exist has been determined, and the properties of these solutions have been derived through extensive numerical integrations. Finally, the stabilities of the different solutions have been examined with respect to the relative energy densities in the form of mass motions and of magnetic fields, and certain general conclusions have been drawn on this basis concerning the likelihood of the different steady—state solutions' being realized in nature. The solutions derived appear to be generally consistent with what is known of the Be phenomenon, to account in at least a semiquantitative way for a number of different aspects of the phenomenon, and to provide a natural point of departure for further studies. (auth)

4191 STUDIES OF HYDRODYNAMIC EVENTS IN STELLAR EVOLUTION. III. EJECTION OF PLANETARY NEBULAE. Kutter, G.S. (The Evergreen State College, Olympia, Washington); Sparks, W.M. Astrophys. J. 192: No. 2, 447-455 (1 Sept 1974).

We investigate the dynamic behavior of the hydrogen—rich envelope (0.101 M$_\odot$) of an evolved star (1.1 M$_\odot$) as the luminosity rises to 19,000 L$_\odot$ during the second ascent of the red—giant branch. For luminosities in the range $3100 < L < 19{,}000$ L$_\odot$ the H—rich envelope pulsates like a long—period variable (LPV) with periods of the order of a year. As L reaches 19,000 L$_\odot$, the entire H—rich envelope is ejected as a shell with speeds of a few times 10 km s^{-1}. The ejection occurs on a time scale of a few LPV pulsation periods. We connect this ejection with the formation of a planetary nebula. Our computations are based on an implicit hydrodynamic computer code. T— and ρ—dependent opacities and excitation and ionization energies are included. As the H—rich envelope is accelerated off the stellar core, we approximate the gap between envelope and core by a vacuum, filled with radiation. Across the vacuum we conserve the luminosity and we take into account the anisotropy of the radiation as well as the solid angle subtended by the remnant star at the inner surface of the H—rich envelope. We assume spherical symmetry and the diffusion approximation. (auth)

4192 THE EVOLUTION OF SUPERNOVA REMNANTS. II. MODELS OF AN EXPLOSION IN A PLANE—STRATIFIED MEDIUM. Chevalier, R.A. (Kitt Peak National Observatory and Princeton University Observatory). Astrophys. J. 192: No. 2, 457–463 (1 Sept 1974).

Numerical models of the remnant of a strong explosion in or near the plane of the galaxy are computed, taking into account the density gradient out of the plane. Special attention is given to the evolution of a blast wave in an exponential atmosphere, which can be scaled to a range of initial parameters. Rough criteria are found for the blast to be contained by interstellar gas pressure and for the top of the remnant never to become thermally unstable. The blast wave from a strong supernova at least 1 scale height above the galactic plane should break out of the Galaxy, resulting in the escape of gas from the Galaxy. The hot, tenuous gas resulting from a typical supernova may contribute to a hot galactic halo. (auth)

4193 MONTE CARLO SIMULATION OF EMISSION FREQUENCIES FROM PARTIAL FREQUENCY REDISTRIBUTION FUNCTIONS. Lee, J. (Operation Research Branch, Naval Research Laboratory, Wahsington, D.C.). Astrophys. J. 192: No. 2, 465-473 (1 Sept 1974).

Simple and efficient algorithms are presented for randomly selecting photon emission frequencies from a class of partial redistribution functions. These formulae are developed by applying some basic rules of probability theory—in particular, Bayes's rule. Theoretical proofs of these formulae are given, and numerical values of the generated frequency distributions are presented to validate the algorithms. These algorithms are intended for Monte Carlo studies of photon diffusion problems. (auth)

4194 A NEW FORMULATION OF AN APPROXIMATE TRANSFER EQUATION. Delache, P. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado). Astrophys. J. 192: No. 2, 475-481 (1 Sept 1974).

Althay's derivation of a transfer equation from a statistical approach is criticized, and a new alternative is presented in which the same equation is established on different grounds. The independent variable which was taken as the reciprocal escape probability is redefined in a slightly different way. The quality of this new formulation is better than the previous one, and can be extended to time—dependent problems where it also shows exceptionally good agreement with the exact solutions. The present work is presented only in the frame of a two—level atom, in an atmosphere of constant T, for the sake of simplicity. However, it is more general, and some possible tests of its validity for complex cases are described. (auth)

4195 HELIUM—SHELL FLASHES IN POPULATION I STARS. Paczynski, B. (California Institute of Technology, Pasadena). Astrophys. J. 192: No. 2, 483-485 (1 Sept 1974).

Population I stars of 3, 3.3, 4, 5, and 6 $M_\odot$ were evolved from the main sequence up to the first strong helium—shell flashes. It is found that the instability of helium—shell burning is initially oscillatory in all the models. Strong thermal pulses develop later. The interpulse period decreases strongly with increasing core mass. (auth)

4196 MAGNETOBRAKING GENERATION OF VECTOR MESONS. Gal'tsov, D. V.; Nikitina, N. S. Vestn. Mosk. Univ., Ser. III. Fiz., Astron.; 15: No. 4, 375-380(1974). (In Russian).

Within the framework of vector dominance consideration is given to the generation of vector mesons for the motion of relativistic electrons in a strong magnetic field. It is shown that under pulsar conditions the process can take place by starting with an electron energy on the order of 10^4 GeV. (SJR)

4197 OPTICAL STUDIES OF UHURU SOURCES. X. THE PHOTOMETRIC HISTORY OF He 2—177 (=3U 1639—62?). Liller, W. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. Lett. 192: No. 2, L89-L91 (1 Sept 1974).

A study of Harvard photographs has revealed that since 1889 the peculiar emission—line star He 2—177 has varied in a quasi—periodic manner between B magnitudes 10.1 and 13.6. He 2—177 is compared with the slow nova RR Tel and with the peculiar nova η Carinae, both of which showed brightness oscillations near times of their outbursts. (auth)

4198 DISSIPATION IN SUPERNOVA SHOCK WAVES. Weaver, T.A. (University of California Lawrence Livermore Laboratory); Chapline, G.F. Astrophys. J. Lett. 192: No. 2, L57-L60 (1 Sept 1974).

Calculations are described which show that the important dissipative mechanism in supernova shock waves is radiation diffusion, not ion viscosity. These calculations show that the ion temperature remains below 100 keV for shock energies up to 30 MeV per nucleon, and thus cast doubt on the idea that supernova shocks can be a significant source of deuterium. (auth)

4199 MODAL STABILITY OF RR LYRAE STARS. Stellingwerf, R. F. Boulder, CO; Univ. of Colorado (1974). 143p. University Microfilms Order No. 74-22,395.

Thesis (Ph. D.).

A new relaxation technique for the calculation of periodic solutions of the nonlinear pulsation problem was developed. In this scheme a forward integration is used to satisfy the time-dependent stellar structure equations, while a Henyey-type relaxation is used to satisfy the periodic boundary conditions. The orbital stability of each periodic solution is also obtained, so the long-term behavior of the stellar model is quickly and accurately determined. Since convergence is rapid, a substantial savings is realized as well. (Diss. Abstr. Int., B)

4200 APPLICATION OF SECULAR STABILITY ANALYSIS TO SEVERAL ASTROPHYSICAL PROBLEMS. Siquig, R. A. Boulder, CO; Univ. of Colorado (1974). 230p. University Microfilms Order No. 74-22,393.

Thesis (Ph. D.).

Secular stability analysis has traditionally been used in two ways in astrophysics: for the general study of the stability properties of stellar models (e.g., the Jeans' criterion); for the study of a specific model or phenomenon (e.g., Mestel's analysis of white dwarf models). The applications considered are similarly of two kinds. For this purpose a general program was written to calculate the eigenvalues and eigenfunctions of the secular problem in the linear perturbation approach. The first application was an attempt to solve an outstanding puzzle in astrophysics, namely the so-called "solar neutrino problem." It had been conjectured that the unexpectedly low observed solar neutrino flux was due to a thermal instability of the sun. Unlike previous analyses of similar models, the problem was correctly formulated by allowing for the nonequilibrium of ^{3}He during the secular perturbations. Unfortunately for fame and fortune, the solar model was found to be secularly stable. Other recent work also seems to rule out the possibility of a secular instability in the sun. The second application of secular stability analysis was for investigating the stability properties of multiple solutions to the equations of stellar structure. When multiple solutions exist, it is important from an observational point of view to know which are secularly stable. Attention was focused on static models with core helium- and shell hydrogen-burning, which, in some range of core masses, have triple solutions. The main conclusion was that the "intermediate" branch of solutions is secularly unstable, while the other two branches are stable. It was also found that in some cases "islands" of solutions could be formed by sufficiently deforming a linear series of models with a varying chemical profile above the hydrogen burning shell. The linear series approach to multiple solutions proved to be useful for interpreting results of evolutionary calculations, like the Cepheid loop, and for predicting other effects, like the minimum mass loss necessary to suppress the Cepheid loop. Several other topics were briefly considered: the inclusion of abundance perturbations in secular analysis; the significance of non-equilibrium of ^{3}He in the secular analysis of the completely convective stars of the lower main sequence; a recently developed computer program that permits the simultaneous determination of the eigenvalues of the secular problem. (Diss. Abstr. Int., B)

4201 EVOLUTION OF PURE ^{12}C WHITE DWARFS. Lamb, D. Q. Jr. Rochester, NY; Univ. of Rochester (1974). 356p. University Microfilms Order No. 74-22,601.

Thesis (Ph. D.).

The evolution of white dwarfs was studied through construction of a relatively accurate equation of state and calculation of an evolutionary sequence of 1 $M_\odot$ pure ^{12}C models. (Diss. Abstr. Int., B)

4202 OUTER LAYERS OF WHITE DWARF STARS. Fontaine, G. Rochester, NY; Univ. of Rochester (1974). 236p. University Microfilms Order No. 74-22,578.

Thesis (Ph. D.).

Models of white dwarf envelopes were constructed in the range $-4.0 \leq \log \mathcal{L} \leq -1.5$ and $0.220 \leq M \leq 1.220$ taking into account the possible existence of convection. The input data are: opacity tables for mixtures representative of white dwarf stars (low metal content) and equation of state tables based on the theory of ionization equilibrium at high densities developed at Lawrence Livermore Laboratories. Most of the models studied have some fraction of the envelope in convection. Above a certain critical luminosity, corresponding to complete ionization at the surface, convection disappears. For lower luminosities convection becomes increasingly efficient and the transition to 100% efficiency is very rapid ($\Delta \log \mathcal{L} \simeq 0.3$). The properties of the convection zones are very sensitive to the choice of the mixing-length in this transition region. At still lower luminosities, the convection becomes adiabatic and thus independent of the mixing length. Only convective solutions reaching the degenerate core have an effect on the total energy content of the star. For these (cool) models, nonideal effects play a dominant role in the stratification of the envelopes. The physical model used leads to the result that convection decreases the core temperatures by at most 50% as compared to radiative models. This conclusion is mixture and model dependent. Physical conditions at the bases of the envelopes are listed for three mixtures (H-rich, He-rich and C-rich). These can be used directly to provide surface boundary values for evolutionary calculations of white dwarfs. (Diss. Abstr. Int., B)

4203 EFFECTS OF THERMAL IMBALANCE ON THE PULSATIONAL STABILITY OF STARS UNDERGOING THERMAL RUNAWAYS. Cox, J.P. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards). Astrophys. J. Lett. 192: No. 2, L85-L87 (1 Sept 1974).

Numerical results are presented for the effects of thermal imbalance on the pulsational stability of one of Gingold and Faulkner's thermally unstable helium—shell—burning models. These effects, though nonnegligible, are considerably smaller than the effects of the nuclear reactions, and do not significantly modify Gingold and Faulkner's qualitative conclusions. The physical interpretation of the stability coefficient is briefly discussed, and the ease of including the effects of thermal imbalance in the stability calculations is pointed out. (auth)

4204 STRUKTURA I DINAMIKA ZVEZDNYKH SISTEM. (Structure and Dynamics of Stellar Systems). Idlis, G. M. Alma-Ata, USSR; Izdatel'stvo Akademii Nauk Kazakhskoi SSR (1961). 314p.

Starting with an analysis of the possible amount and general type of single-valued primary integrals of the movement of individual stars able to enter independent arguments into the phase density of the stellar system, a general theory is developed of self-gravitating final stationary stellar systems. The theory explains the presence and deep interaction of all the most fundamental structural, kinematic, and dynamic properties of the respective real galaxies. Based on this theory, conclusions are made concerning the functional and universal first approximation for the gravitational potential in the equatorial density within the stellar system (generalized formula of Parenazo). A general method is given for constructing a detailed model of stellar systems with the gravitational potential of Parenazo in the equatorial density within them. Such models are applied to the galaxy and to different extra-galactic nebulas. They make it possible not only to precisely relate the physical characteristics of these systems but also to solve some important problems of a cosmogonic nature and to establish actual theoretical and observed problems for further study. The book is designed for astronomers, operators, and physicists interested in problems of structure, dynamics, and evolution of stellar systems. (tr-auth)

4205 QUANTITATIVE ANALYSIS OF THE ATMOSPHERE OF 55 CYG. Zeinalov, S. K. Tsirk. Shemakh. Astrofiz. Observ.; No. 6, 11-18(Jun 1973). (In Russian).

The star 55 Cyg belongs to spectral class BZ of the supergiant type 1a. It is a visible star of magnitude 4^{m} 89. Spectral lines of hydrogen, helium, magnesium, silicon, oxygen, carbon and nitrogen were investigated. All these elements (except hydrogen) in the atmosphere of Cyg 55 are in the ionized state. The wavelength, the central depth R_0, the half-width $\Delta\lambda$ (in mm at half the central depth $R_0/2$), and equivalent width W_λ (in Å) are presented for various lines of these elements on different dates of the years 1962–1963. A variability in the atmosphere of the star was detected with two maxima and two minima being noted in the line widths and heights as a function of date of observation. Layering of the atmosphere of the star is assumed to explain the variations in phase. (SJR)

4206 ABSENCE OF SOFT X RAYS FROM ETA CARINAE. Griffiths, R. E. (Univ. of Leicester, Eng.); Peacock, A.; Pagel, B. E. J. Nature (London); 250: No. 5469, 714-715(30 Aug 1974).

A search was made in May 1973 for x-ray emission from Eta Carinae with the x-ray telescopes on the satellite OAO-Copernicus. The instrumentation comprised two paraboloidal telescopes operating in the energy ranges 0.5 to 1.5 and 1.5 to 4.6 keV, with a separate collimated proportional counter operating at 2.5 to 7.5 keV. Possible energy sources of Eta Car, together with suggested models, are discussed; it was considered that x-ray observations would be of great value in helping to decide between the models and in setting constraints to the physical parameters involved. No x-rays were detected, strongly favouring the view that the spectrum of Eta Carinae is of thermal origin, with the bulk of the energy coming from dust grains. (UK)

4207 HIGH TEMPERATURE NUCLEAR ASTROPHYSICS. Fowler, W. A. (California Inst. of Tech., Pasadena). Quart. J. Roy. Astron. Soc.; 15: No. 2, 82-106(Jun 1974).

The lecture is concerned with temperatures in excess of 5×10^8K and nuclear processes, beyond hydrogen and helium burning, occurring during the short-lived, advanced stages of stellar evolution. These are referred to as carbon burning, oxygen burning and silicon burning with both quasi-equilibrium and explosive conditions playing a role. The range of atomic masses involved is from $A = 12$ to about 60. Possible astrophysical sites for high-temperature nucleosynthesis are considered. It is pointed out that high-temperature astrophysics presents new problems to the nuclear physicist, particularly in view of the large number of possible nuclear reactions involved. A second set of new problems arises from the wide range of time scales, ranging from 10^{-1}s for explosive events to 10^{12}s for hydrostatic carbon burning. Reaction rate systematics are discussed. In conclusion, it is stated that nuclear data are rapidly accumulating, but the experiments are difficult and are limited to measurements on the ground states of stable nuclei as targets. Radioactive nuclei and excited states are evolved as products, and transmission functions involving these cases can be checked experimentally. Within the framework of the Hauser–Feshbach statistical theory, there is substantial indication of systematic behaviour for the average cross-sections of reactions between intermediate mass nuclei and n, p, α and γ. Theoretically reasonable analytic functions for experimental nuclear reaction rates are gradually becoming available. (UK)

4208 RADIAL PULSATIONS OF FINITE ISOTHERMAL GAS SPHERES. Taff, L. G.; Van Horn, H. M. (Univ. of Rochester, NY). Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 427-432 (Aug 1974).

The pulsational properties of finite isothermal gas spheres contained in an ambient, external medium are studied. An error in a previous analysis is corrected, and the eigenvalue problem is solved by direct numerical integration. Adiabatic pulsations, which have not been previously considered, as well as isothermal pulsations are investigated. The calculations are extended to a large dimensionless radius ($x_0 = 100$) in order to determine the systematic variations of the pulsational properties. Tables of the eigenvalues plus characteristic features of the eigenfuctions are given as functions of x_0, and the fundamental and first harmonic eigenfunctions are displayed graphically. (auth)

4209 BLACK HOLES IN THE EARLY UNIVERSE. Carr, B. J.; Hawking, S. W. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 399-415(Aug 1974).

The existence of galaxies today implies that the early Universe must have been inhomogeneous. Some regions might have gotten so compressed that they underwent gravitational collapse to produce black holes. Once formed, black holes in the early Universe would grow by accreting nearby matter. A first estimate suggests that they might grow at the same rate as the Universe during the radiation era and be of the order of 10^{15} to 10^{17} solar masses now. The observational evidence, however, is against the existence of such giant black holes. This motivates a more detailed study of the rate of accretion which shows that black holes will not in fact substantially increase their original mass by accretion. There could thus be primordial black holes around now with masses from 10^{-5} g upwards. (auth)

4210 FURTHER STUDIES OF THE OPTICAL VARIABILITY OF OJ 287. Frohlich, A.; Goldsmith, S.; Weistrop, D. (Tel Aviv Univ., Israel). Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 417-425(Aug 1974).

Photoelectric and photographic observations of OJ 287 are presented and discussed. A periodogram analysis of two continuous series of photoelectric observations supports the 40-min periodicity suggested by Visvanathan & Elliot (Astrophys. J.; 179:721 (1973)). The stability of OJ 287 on time scales of seconds and minutes, as found from optical power spectra, is also discussed. The UBV photometry, combined with those previously reported in the literature, shows no dependence of colour on magnitude. (auth)

4211 VARIATIONAL PRINCIPLES FOR THE ELLIPTICITY OF SLOWLY ROTATING CONFIGURATIONS. Rau, A. R. P. (Tata Inst. of Fundamental Research, Bombay). Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 273-286(Aug 1974).

Among the quantities characteristic of a slowly rotating, gravitationally-bound system that are of interest are the eccentricities, $\epsilon(r)$, of interior surfaces, the eccentricity, $\epsilon_R \equiv \epsilon(R)$, at the surface, and the ratio, M, of the centrifugal acceleration at the equator to the gravitational acceleration at the surface. These quantities are determined in terms of the mass distribution, M(r), of the corresponding, non-rotating state of the system through the solutions of a second-order differential equation due to Clairaut. This paper constructs variational principles for the determination of these quantities and points out that techniques familiar in quantum-mechanical scattering theory can be adapted to provide strict variational upper and lower bounds for the ratio M/ϵ_R. Some examples are presented to illustrate that the bounds are of good quality. (auth)

4212 SPECTROSCOPIC STUDIES OF FLARE STARS: EV LAC, EQ PEG, AD LEO AND V1054 OPH. Bopp, B. W. (Univ. of Texas, Austin). Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 255-261(Aug 1974).

The results of a programme of high dispersion coudé observations of four flare stars are reported. None of the stars exhibited significant radial velocity variations; it is argued that the existence of a close, short-period companion is not a necessary condition for flare activity. EV Lac and EQ Peg are found to show marked emission-line variability while photometrically quiescent, similar to the variations recently reported in five other flare stars (Bopp, Mon. Not. R. astr. Soc.; 166:79(1974)). The variability can be explained by a non-uniform, patchy distribution of emitting regions on a rotating star. (auth)

4213 RADIATION PRESSURE DRIVEN MASS LOSS FROM ACCRETION DISCS IN X-RAY BINARIES. Wickramasinghe, D. T. (Australian National Univ., Canberra). Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 297-305(Aug 1974).

Possible mechanisms for the origin of gas streams in X-ray binaries with a supergiant component are discussed. It is shown that even at sub-critical rates of accretion, radiation pressure driven mass loss from the outer extremes of an accretion disc is possible in the presence of a sufficiently high flux of soft X-rays. In these circumstances radiation pressure may also inhibit the development of an appreciable stellar wind from the surface facing the X-ray source. (auth)

4214 PHYSICAL PROPERTIES OF THE RED GIANTS IN M67. Osborn, W. (Instituto Venezolano de Astronomia, Merida, Venezuela). Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 291-296(Aug 1974).

The effective temperatures, surface gravities and masses of 16 red giant members of the old galactic cluster M67 have been derived from existing intermediate-band photometry on the David Dunlap Observatory (DDO) system. Most of the stars have masses in the range 1.5 to 2.5 $M_\odot$, but two stars were found to have considerably smaller masses of the order of 0.5 $M_\odot$ which may indicate that they are in the horizontal branch stage of evolution after having suffered mass loss. The derived physical parameters have been used to estimate the helium abundance of the cluster by the method given by Gross (Mon. Not. R. Astr. Soc.; 164: 65 (1973)) with the result $Y_{M67} \geq 0.20$. (auth)

4215 BAR MODES OF UNIFORMLY ROTATING STELLAR DISKS. Kalnajs, A. J.; Athanassoula-Georgala, E. (Australian National Univ., Canberra). Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 287-290(Aug 1974).

A self-gravitating stellar disk in which the mean as well as the circular velocity of the stars is one of uniform rotation has three bar-like modes. If the ratio of mean to circular velocity exceeds $(125/486)^{1/2} = 0.5072$, one of these modes becomes unstable. The pattern speed of the unstable bar is between $(5/24)^{1/2}$ and $1/2$ the angular velocity of a star in a circular orbit. (auth)

4216 BY DRA-TYPE STARS. Chugainov, P. F. Izv. Krym. Astrofiz. Observ.; 48: 3-22(1973). (In Russian).

The properties of BY Dra-type stars are discussed on the basis of the hypothesis supposing that their light variations are due to the presence of a spot on the surface of rotating star. The increase of the mean brightness of BY Dra and the decrease of its color index observed from 1965 to 1966 to 1970 is interpreted as the result of either decrease of total area of a spot or increase of its effective temperature. It is found that the period of BY Dra is changing, the change being in phase with its light variations. The assumption is made on existence of 8–9-year cycle in variations of the period, the mean brightness and the color index of BY Dra. The results of photoelectric observations of FF And, EV Lac and Gliese 616.2, 781, 809, 815, 829, 875.1, 880 are also given. The period of light variations of FF And in 1971 was the same as in 1966 to 1967. The period of Gliese 875.1 in 1971 is found to be $2^d.549$. The flare activity of BY Dra, Gliese 781, 815, and 875.1 is detected. The observations of the other stars do not reveal light variations greater than 0.01m–0.02m. (auth)

4217 TOPOLOGICAL PUMPING OF MAGNETIC FLUX BY THREE-DIMENSIONAL CONVECTION. Drobyshevski, E. M.; Yuferev, V. S. (Ioffe Inst. of Physics and Tech., Leningrad). J. Fluid Mech.; 65: No. 1, 33-44(12 Aug 1974).

Attention is drawn to a principal difference between the transfer of a horizontal magnetic field by turbulence and by three-dimensional cell convection. If the motion of the conducting medium in the cells is such that the heated material ascends at the centre while descending along the sides of the cells, then the magnetic tubes of force will be carried downwards by peripheral flows. Discrete ascending flows separated from one another by descending material carry only closed magnetic field loops. Such loops do not transfer net magnetic flux. As a result, the magnetic flux becomes blocked at the base of the convective layer. (auth)

4218 NOVOPODOBNYE I NOVYE ZVEZDY. (Nova-like and New Stars). Gorbatskii, V. G. Moscow; Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko-Mathematicheskoi Literatury (1974). 184p.

The physical properties of close binary systems of star dwarfs were discussed in detail. In this class of objects occur new stars and eruptive stars of other types. Some of these systems are sources of x radiation. A systematic discussion was given of the results of theoretical studies of new and nova-like stars outside of flares. The dynamic principles in close binary systems, the formation of gaseous currents and their effect on the observed properties of the system were examined. The different forms of heat instabilities leading to flares of novas and repeated novas and the role of close binary systems in the evolution of the galaxy were described. (tr-auth)

4219 REFLECTION EFFECT IN FLARE STARS. The Light and Color Curves for the Flares of UV Cet-Type Stars. Grinin, V. P. Izv. Krym. Astrofiz. Observ.; 48: 58-72(1973). (In Russian).

The two-component model proposed by Kunkel for the flares of UV Cet-type stars is analyzed quantitatively. The transfer problem in case of nonstationary radiation in grey atmosphere disturbed by the radiation of the flare is considered. It is assumed that the temperature disturbance in the atmosphere is small in comparison with the undisturbed value of temperature. Theoretical light curves are constructed for the total radiation (flare and disturbed atmosphere) in the UBV-systems and theoretical variations of colors U–B, B–V are calculated. The comparison of calculated and observed data shows that observed Kunkel's variation of the color of the flare and of the slow component in the light curve (in a visual region) may be explained by the radiation of disturbed atmosphere. It is noted that results of two-color Chugainov's and other authors' observations are not in agreement with the considered version of the two-component model of the flare. The change of color of the flare's own radiation may be the cause of this discrepancy. It is shown that the minimum height of a flare (of mean intensity, $L \sim 10^{32}$ ergs) must be $r_{min} = 0.06\ R_*$ above the surface of a star in order to realize the condition of the small temperature disturbance. (auth)

4220 SPECTRA OF AD LEO FLARE FEB 18, 1971. Kulapova, A. N.; Shakhovskaya, N. I. Izv. Krym. Astrofiz. Observ.; 48: 31-36(1973). (In Russian).

Four spectrograms with the dispersion 150 Å/mm were obtained during the flare of AD Leo on Feb. 18, 1971. The spectrophotometric measurements show that the width of H_α-line (on the half intensity level) reaches 15 Å on the spectrogram taken near the brightness maximum. Such a wide line is observed for UV Cet-type stars for the first time. The line width recovers to the normal level more slowly than the brightness of the star. The following peculiarities are observed in the profiles of the emission lines: the blue wing of H_α-line is more steep, around the maximum of brightness than the red one; the tops of line profiles are more flat in the phase of the brightness decrease and the small depression of intensity is visible at the centers of H_β, H_γ, H_δ. (auth)

4221 SPECTROSCOPY OF EE PEG. Rachkovskaya, T. M. Izv. Krym. Astrofiz. Observ.; 48: 23-30(1973). (In Russian).

A spectrum of the primary component of the eclipsing-variable system EE Peg was studied using the spectrograms with dispersions 15 and 36 Å/mm within the interval λλ3700 to 4600 Å. The primary component EE Peg lies on the main sequence (Sp = A3; $M_V = +1^m, 8$) and possibly possesses the axial–orbital synchronism (v sin i = 37 km/sec; v_{syn} = 38 km/sec). The EE Peg atmosphere is analyzed by the curve of growth method. The Wrubel's curve of growth was used as the theoretical curve. The following parameters of the stellar atmospheres were obtained: the turbulent velocity v_t = 4.2 km/sec; the excitation temperature T_B (Fe I, Ti II) = 7300°; the electron pressure (from iron lines) lg P_e (Fe) = 1.65; and the abundance of elements Fe, Ca, Ti. The turbulent velocity and the electron pressure are inside the range of these values for the main sequence stars. The abundance of Ca and Ti in the atmosphere EE Peg and of the sun is probably the same. The iron abundance in EE Peg is somewhat less than in the sun. (auth)

4222 THEORY OF RADIATION TRANSFER IN THE PRESENCE OF A MAGNETIC FIELD. Rachkovskii, D. N. Izv. Krym. Astrofiz. Observ.; 47: 3-6(1973). (In Russian).

The formation of absorption lines in a homogeneous atmosphere with a constant magnetic field is considered. Only true absorption is taken into account. A new expression for radiation escaping from the atmosphere is obtained. (auth)

4223 SPECTROPHOTOMETRICAL STUDY 15 VUL. Boyarchuk, A. A.; Mamatkazina, A. Kh. Izv. Krym. Astrofiz. Observ.; 47: 125-138(1973). (In Russian).

The equivalent widths of 871 lines were determined. Curves of growth were constructed, and parameters of the atmosphere and chemical composition were determined. Sulfur, nickel, and more heavy elements were overabundant. (auth)

4224 OBSERVATIONS OF THE Li I 6708 LINE IN THE SPECTRA OF SOME MAGNETIC VARIABLE STARS. Polosukhina, N. S. Izv. Krym. Astrofiz. Observ.; 47: 118-124(1973). (In Russian).

Positions of the center of gravity of the line Li I 6708 were measured at the spectra of magnetic variable stars. A red shift of this line as compared to spectra of normal stars was noted. Some possible reasons for this shift is advanced. (auth)

4225 FLARE ACTIVITY OF THE RED DWARF BD + 43°44 AB. Shakhovskaya, N. I. Izv. Krym. Astrofiz. Observ.; 47: 111-117(1973). (In Russian).

By photoelectric monitoring of the red dwarf stars BD + 43°44 A and BD + 43°44 B (in a photometric system close to B) a flare activity of UV Cet type was discovered. The position of these stars in H–R diagram and their kinematic characteristics shows that the age of the system under consideration is about 10^9 years. These facts support the suspicion that the flare activity is common to old stars also. The emission lines Ca II and H, usually found in the quiet state spectra of UV Cet type stars, are absent or very weak in the system BD + 43°44 AB; their equivalent widths are less than 0.5 to 1.0 Å. For the stars investigated the ratio of emission in the Ca II and H lines to the photospheric background in the chromospheres (if these are really existing) is at least 5 to 10 times lower when compared to that of the other UV Cet stars studied before. (auth)

4226 SPECTROPHOTOMETRIC INVESTIGATION OF THE SPECTROSCOPIC-BINARY STAR α VIRGINIS. Galkina, T. S. Izv. Krym. Astrofiz. Observ.; 47: 83-110(1973). (In Russian).

The composite spectrum of α Virginis is analyzed on the basis of 228 spectrograms obtained with the dispersions of 15 Å/mm in the region λλ 4950–3650 Å and of 37 Å/mm in the region λλ 7000 to 5700 Å. The different phases of the orbital (4,014 days) and short (4.17 hours) periods were studied. The spectral classes of the components are estimated as B1, 2 ± 0.2 and B3. Luminosities and radii of the components were found and a schematic model of the system α Virginis was proposed. It is shown that the complicated structure of absorption lines in the spectrum of α Virginis, and variations of their intensities may be explained by the instability of the β Canis Majoris type of the primary of α Virginis, and by the absence of the synchronization of rotational and orbital periods also. The observed data confirm the O. Struve–G. J. Odgers hypotheses explaining the processes in the β Canis Majoris type stars. (auth)

4227 EVOLUTION OF STARS AND THEIR FINAL PRODUCTS. Guseinov, O. Kh. Tsirk. Shemakh. Astrofiz. Observ.; No. 32-33, 3-5(1973). (In Russian).

The theory of stellar evolution has been able to estimate correctly the lifetimes of stars of different masses at various evolutionary stages. The existence of evolutionary succession in a system where a red giant planetary nebula becomes a white dwarf has been argued successfully in a previous study. The broader question of what the masses of stars should be in the main evolutionary succession in order that the final product becomes a white dwarf is discussed in this paper. Three well-known binary systems containing white dwarfs are considered: Sirius, Procyon and 40 o^2 Eridan. In all three pairs the formation of white dwarfs can be explained by a large loss of mass from the system as a whole. It is concluded that a white dwarf with a mass of 0.98 M_0 can be formed in the process of evolution of a star with a mass ~3 M_0. Thus there is a basis to believe that all stars with a mass <3M_0 can be converted into white dwarfs. In other words, all stars with mass <3 M_0 in the process of evolution lose ~70% of their initial mass. The result of the collapse and explosion of a supernova should almost always be the birth of a neutron star and not of a black hole which, however, may exist in x ray sources of the type of Lebed′-1, where the probability for the existence of a black hole is about 90%. (SJR)

4228 SPECTRAL OBSERVATIONS OF EMISSION STARS FROM THE ASSOCIATION Cep OB 2. Aslanov, I. S. (Shemakha Astrophysical Observatory, USSR); Akhundova, G. V.; Ivanova, N. L. Tsirk. Shemakh. Astrofiz. Observ.; No. 32-33, 6-10(1973). (In Russian).

A detailed spectrophotometric study is presented on the spectra of three emission stars of type B. Equivalent widths, half widths and central residual intensities of H and He 1 lines are tabulated. The equivalent widths were used to determine the electron density n_e and electron pressure P_e. It was assumed that the main reason for hydrogen line broadening was the Stark effect. (SJR)

4229 DISTRIBUTION OF TEMPERATURE WITHIN WHITE DWARFS. Seidova, P. I.; Eminzade, T. A. Tsirk. Shemakh. Astrofiz. Observ.; No. 32-33, 11-15(1973). (In Russian).

Near the boundary of degeneracy in a white dwarf there is a perceptible rise in temperature. In other words the degenerate region of the star is not completely isothermal. An exact calculation of the temperature gradient is carried out by numerical integration of an equation of the radiant equilibrium. Coefficients of radiant and conductive nontransparency are estimated. It was found that the temperature increases not only in the shell but also in the degenerate region of white dwarfs. The results of the calculations show that the central temperature is about a factor of 1.3 higher than the temperature at the boundary of the degeneracy. A comparison with more exact calculations shows satisfactory agreement in values of the central temperature. Hence by using concepts of nontransparency and density in analytical form it is possible to obtain correct values of the central temperature with considerable simplification of the calculations. (SJR)

4230 SPECTRAL LINE BROADENING. van Regemorter, H. (Paris Observatory, Meudon, France). pp 85-119 of Atoms and Molecules in Astrophysics. Carson, T. R. (ed.). New York; Academic Press, Inc. (1972).

From 12th session of Scottish universities summer school in physics atoms and molecules in astrophysics; Stirling, UK (Aug 1971). See CONF-710859-.

This review of the line profiles emitted by laboratory and astrophysical plasmas covers the pressure broadening of spectral lines due to the interactions of the radiating atoms with surrounding particles including thermal motion of the emitting atom (Doppler broadening) and natural broadening and interaction of the atom with the radiating field. These kinds of broadening are combined to consider the case when the pressure broadening is more important than the others (when the density of the plasma is high enough, the radiation field is weak). The basic principles and basic methods in line broadening theory are mainly considered. (JFP)

4231 NON-EQUILIBRIUM PROCESSES IN INTERSTELLAR MOLECULES. Litvak, M. M. (Smithsonian and Harvard Observatory, Cambridge, MA). pp 201-276 of Atoms and Molecules in Astrophysics. Carson, T. R. (ed.). New York; Academic Press, Inc. (1972).

From 12th session of Scottish universities summer school in physics atoms and molecules in astrophysics; Stirling, UK (Aug 1971). See CONF-710859-.

The likely causes of the nonequilibrium effects appearing so strikingly on the OH and water masers (anomalous emitters) and the OH and formaldehyde antimasers (anomalous absorbers) and appear more subtley in the recently discovered cyanoacetyline and methanol molecules for example. A list is given of those interstellar molecules known at this time by their microwave lines, date of discovery, the quantum numbers for the levels involved in the microwave transitions, the line rest frequencies, and astronomical objects they were observed in, the estimated maximum projected densities, and the Einstein coefficient for the spontaneous radiative transition. (JFP)

4232 RADIO RECOMBINATION LINES: AN OBSERVER'S POINT OF VIEW. Churchwell, E. (Max-Planck-Institut fuer Radioastronomie, Bonn). pp 277-283 of Atoms and Molecules in Astrophysics. Carson, T. R. (ed.). New York; Academic Press, Inc. (1972).

From 12th session of Scottish universities summer school in physics atoms and molecules in astrophysics; Stirling, UK (Aug 1971). See CONF-710859-.

The observed properties of radio recombination lines and the importance of these lines in astronomy including the probe of the interstellar medium and atomic processes under interstellar conditions: collisional broadening in a high temperature low density gas. (JFP)

4233 SOME RECENT ASPECTS OF SPECTROSCOPY AT UV AND X-RAY WAVELENGTHS. Speer, R. J. (Imperial Coll. of Science and Tech., London). pp 285-310 of Atoms and Molecules in Astrophysics. Carson, T. R. (ed.). New York; Academic Press, Inc. (1972).

From 12th session of Scottish universities summer school in physics atoms and molecules in astrophysics; Stirling, UK (Aug 1971). See CONF-710859-.

Some aspects that are common to the seemingly widely different new sciences of solar ultraviolet and x-ray spectroscopy and x-ray stellar astronomy are examined, and these aspects are then related to knowledge gained from ultraviolet and x-ray laboratory spectroscopy. Some very recent new developments in eclipse astronomy and diffraction grating physics are included which graphically illustrate the interdependence and progress between widely separated disciplines. (JFP)

4234 FORMATION OF H_2 MOLECULES IN DARK INTERSTELLAR CLOUDS. de Jong, T. (Sterrewacht, Leiden). pp 327-335 of Atoms and Molecules in Astrophysics. Carson, T. R. (ed.). New York; Academic Press, Inc. (1972).

From 12th session of Scottish universities summer school in physics atoms and molecules in astrophysics; Stirling, UK (Aug 1971). See CONF-710859-.

The problem of H_2 formation by low energy cosmic rays is considered. Calculations of the density of atoms (H), positive ions (H^+), negative ions (H^-), molecules (H_2), positive molecular ions (H_2^+,H_3^+), and electrons in a dark cloud with kinetic temperature $T_k = 50$°K are presented. It is shown that the formation of H_2 molecules may also proceed through associative detachment of the H^- ion. (JFP)

4235 FORMATION OF MOLECULAR HYDROGEN ON COLD SURFACES. Schutte, A. pp 337-340 of Atoms and Molecules in Astrophysics. Carson, T. R. (ed.). New York; Academic Press, Inc. (1972).

From 12th session of Scottish universities summer school in physics atoms and molecules in astrophysics; Stirling, UK (Aug 1971). See CONF-710859-.

The formation reaction $H + H \rightarrow H_2$ is studied in a molecular beam apparatus. The time evolution of the measured energy per H_2 molecule at 3 and 5°K, the measured energy per pair of H atoms as a function of surface contamination with H_2, and the time evolution of the atomic hydrogen signal after depositing one layer of H_2 on the surface. (JFP)

4236 EMISSION-LINE SPECTRA AS PROBES OF DUST CLOUDS. Pagel, B. E. J. (Royal Greenwich Observatory, Hailsham, Eng.). pp 341-345 of Atoms and Molecules in Astrophysics. Carson, T. R. (ed.). New York; Academic Press, Inc. (1972).

From 12th session of Scottish universities summer school in physics atoms and molecules in astrophysics; Stirling, UK (Aug 1971). See CONF-710859-.

A discussion is given of the use of emission lines to deduce some properties of dust clouds in three cases: M82, Seyfert galaxies, and the object η Carinae in the milky way. (JFP)

4237 INVESTIGATION OF UV OSCILLATOR STRENGTHS IN C, N, AND O IONS. Mallow, J. V. (Univ. of Jerusalem). pp 347-352 of Atoms and Molecules in Astrophysics. Carson, T. R. (ed.). New York; Academic Press, Inc. (1972).

From 12th session of Scottish universities summer school in physics atoms and molecules in astrophysics; Stirling, UK (Aug 1971). See CONF-710859-.

A number of radiative lifetimes for resonance transitions in ions and neutral atoms of carbon, nitrogen, and oxygen were measured. A previous technique for measuring molecular lifetimes in the range 20 to 100 nanoseconds and in the visible part of the spectrum was modified. The measurements are for vacuum ultraviolet resonance transitions with lifetimes typically less than 10 nsec. The advantages of this pulse decay technique over the comparable phase shift method are noted. (JFP)

4238 GAS LOSSES BY CLOSE BINARY SYSTEMS. Fedorova, A. V. Vestn. Leningrad. Univ., Ser. Mat., Mekh. Astron.; 138-144 (Oct 1973). (In Russian).

The gas losses by a close binary are calculated with allowance for the expansion of the gas stream flowing from the secondary to the primary component. The amount of matter passing along the disk is determined for beta-Lyr and DQ Her. (IAA)

4239 BLACK HOLE EQUILIBRIUM STATES. Carter, B. (Cambridge Univ., Eng.). pp 57; 59; 61-214 of Black Holes. New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 23rd summer school of theoretical physics; Les Houches, France (1 Aug 1972).

Analytic and geometric properties of the Kerr solutions are considered, giving attention to spheres and pseudospheres, the derivation of the spherical vacuum solutions, the maximal extensions of the spherical solutions, the derivation of the Kerr solution and its generalizations, the maximal extensions of the generalized Kerr solutions, the domains of outer communication, and the integration of the geodesic equations. Questions concerning the general theory of stationary black hole states are also discussed, taking into account the domain of outer communications and the global horizon, axisymmetry and the canonical Killing vectors, the properties of Killing horizons, the Hawking–Lichnerowicz theorem, the four laws of black hole mechanics, and the boundary conditions for the vacuum black hole problem. (IAA)

4240 EVENT HORIZON. Hawking, S. W. (Cambridge Univ., Eng.). pp 1; 3; 5-55 of Black Holes. New York; Gordon and Breach, Science Publishers, Inc. (1973).

From 23rd summer school of theoretical physics; Les Houches, France (1 Aug 1972).

Aspects of a spherically symmetric collapse are considered together with a nonspherical collapse, questions of conformal infinity, causality relations, the focusing effect, and problems of predictability. The formation and evolution of black holes is discussed, giving attention to the need for a suitable time coordinate. As the time function increases, black holes may grow or merge together and new black holes may be formed by further stars collapsing. However, a black hole, once formed, cannot disappear, nor can it bifurcate. The final state of black holes is considered along with perturbations of black holes and time symmetric black holes. (IAA)

4241 HYDROGEN AND HELIUM SPECTRA IN MAGNETIC WHITE DWARF STARS. Kemic, S. B. Boulder, CO; Univ. of Colorado (1973). 166p. University Microfilms Order No. 74-12,384.

Thesis (Ph. D.).

Recent observations of continuum circular polarization have indicated the presence of magnetic fields on the order of 10^7 gauss or more in several white dwarfs, all of which also exhibit peculiar line spectra, consisting of broad unidentified features. The purpose is to investigate the formation of white dwarf spectral lines in the presence of large magnetic fields. The quadratic Zeeman effect in hydrogen and helium was calculated. Eigenvalues and eigenvectors were found by diagonalizing the truncated matrix of the perturbed Hamiltonian. Radial matrix elements in the case of helium were found using the Coulomb approximation. Energies found in this way are presented for hydrogen states up to $n = 5$ and helium configurations 1snl with $n = 2$ to 6 and $l = 0$ to 4, both singlets and triplets. The result of this effect is a blue shift superimposed upon the Paschen-Back splitting in all components of a spectra line. Additionally, mixing produced by the field gives rise to lines forbidden in the zero field case. A schematic model atmosphere of the Milne-Eddington type was then used to predict the appearance of these spectra in a white dwarf having a dipole magnetic field. In such cases the variation of the field over the surface of the star is the dominant factor in determining the final shape of the spectral feature. Results are presented for the spectrum of helium including all lines between 3900Å and 6000Å for fields from 5×10^6 to 1.5×10^7 gauss and for the hydrogen lines Hα, Hβ and Hγ for fields from 5×10^6 to 1×10^7 gauss. Orientations of the dipole axis relative to the line of sight of 0, 45 and 90° were considered. A number of spectral lines of these elements, although broadened and shifted, should be identifiable at these fields. Yet high fields may be necessary to explain observed spectra in magnetic white dwarfs. A dipole field of about 8×10^7 gauss is necessary to completely wash out all helium lines. About 2×10^8 gauss is required in the case of hydrogen. The spectrum of the magnetic white dwarf Grw + 70°8247 shows a good coincidence with the spectrum predicted for hydrogen at a field of about 1.2×10^8 gauss; however, the features in the predicted spectrum are too broad, suggesting that if this identification is correct, a field configuration other than that of a dipole is responsible. (Diss. Abstr. Int., B)

4242 APSIDAL CONSTANT AND PULSATIONAL CHARACTERISTICS OF ALPHA VIRGINIS. Odell, A. P. Madison, WI; University of Wisconsin (1974). 54p. University Microfilms Order No. 74-10,259.

Thesis (Ph. D.).

The evolution of Alpha Virginis is compared to theoretical models through predictions of apsidal motion and pulsation periods. The best fit to the apsidal constant is obtained for a mixed star, with a composition discontinuity at the main sequence convective core boundary. If the interferometric observations are correct, the apsidal test rules out the nonmixed evolution using Cox–Stewart opacities. Models calculated with increased opacities of metals can also fit all observations if the model atmospheres of Van Citters and Morton are used. The pulsation period yields best agreement with the unmixed models, Cox–Stewart opacities, but the mixed models are not ruled out entirely. The presently observed period cannot be due to the radial fundamental, and is probably due to the first overtone (assuming no mixing) or a second overtone (assuming mixing or high opacities) of either radial or nonradial but with $l = 2$. In the unmixed case, the present period might be the $l = 2$ fundamental mode. In any case, the star is most likely in the late stages of overall gravitational contraction. Only during this phase can one fit the apsidal constant, present temperature, present pulsation period, and sign of the rate of change of the period. (Diss. Abstr. Int., B)

4243 PHOTONEUTRINO REACTION IN A SUPERSTRONG MAGNETOACTIVE PLASMA. Chou, C. K. New York; New York Univ. (1973). 97p. University Microfilms Order No. 74-13,313.

Thesis (Ph. D.).

The description of photoneutrino emission in a superstrong magnetoactive degenerate electron plasma is formulated in the language of quantum field theory, and consider in detail, at temperatures, densities, and magnetic field strength expected for neutron stars, the photoneutrino luminosity due to the various modes of plasmon excitations at an arbitrary angle relative to the static homogeneous magnetic field. The general results are applied to the important special cases for propagation of transverse plasmons along or across the external magnetic field. The differential energy loss rate L(H) for the circularly polarized plasma waves propagating along the field are significantly reduced relative to the field free case L(O) at temperatures in which the photoneutrino reaction is important. The decrease of L(H) at low densities $\rho/\mu_e \lesssim 10^6$ is due to the presence of the strong magnetic field whereas the reduction of L(H) at high densities $\rho/\mu_e \gtrsim 10^6$ is due to plasma effects. The relative importance of the photoneutrino process compared to the other competing neutrino reactions in a magnetic field is assessed. Possible applications of the results to the cooling of pulsars are discussed, and the general qualitative features of the evolution of a magnetized neutron star are briefly described. (Diss. Abstr. Int., B)

4244 CONSTRAINTS ON THE MIXING AND EVOLUTION OF THE PECULIAR RED GIANTS. Scalo, J. M. Los Angeles; Univ. of California (1974). 292p. University Microfilms Order No. 74-12,471.

Thesis (Ph. D.).

A significant fraction of the red giant stars have peculiar spectra. These stars are classified as types Ba, R, N, S, MS, SC, and CH. The basic anomaly common to all these stars is a decrease in the difference between the oxygen and carbon abundances, denoted O−C, relative to normal giants of similar temperature, as is inferred from the strengths of various molecular bands. The spectral features of many of these stars also indicate anomalous abundances of lithium, heavy elements, and ^{13}C. All evidence supports the idea that these stars have undergone mixing between the deep stellar interior and the surface. The nuclear processes which can occur in the deep interior of red giants are adequate to explain the observed spectral peculiarities, and can be well defined. On the other hand, the physical mechanisms responsible for the mixing, the phase of evolution which the stars represent, and the relation between the various classes of peculiar red giants remain unknown, and present a serious challenge for the theory of stellar evolution and nucleosynthesis. The present investigation is an attempt to compare the observational data, including spectra, photometry, spatial, and velocity distributions, and mass estimates, with the possible mixing mechanisms which have so far been proposed. The two basic procedures which are employed involve a comparison of observed line and band strengths with the predictions of ionization and dissociation calculations, and a comparison of infrared temperatures and luminosities with theoretical evolutionary tracks. (Diss. Abstr.)

4245 STARS WITH He-CORES. Refsdal, S. (Hamburger Sternwarte, Hamburg). Mitt. Astron. Ges.; No. 34, 65-74(1973).

From proceedings of the astronomical society; Oberkochen, Germany (24 Apr 1973).

It is pointed out that the relative number of observed He-core stars is larger than the relative time scales indicate, since the luminosity of these stars is generally higher than that of main sequence stars. A schematic survey of stars with He cores is conducted, giving attention to the types of He core, the hydrogen profile in a step-profile model, an H−R diagram for sequences of equilibrium models, the location of step-profile models with central He-burning, and an approximation of the real H profile during central He burning. (IAA)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 4165, 4197, 4348, and 4349.

4246 OBSERVATIONS OF M82 AT 5 GHz WITH 5-km RADIO TELESCOPE. Hargrave, P. J. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 491-503 (Sep 1974).

The Cambridge 5-km radio telescope has been used to map M82 at 5 GHz with a resolution of 2.0″ arc in right ascension and 2.1″ arc in declination. The map reveals a source 50″ × 15″ arc in extent, with major axis close to that of the optical galaxy. Five per cent of the flux originates from a compact object < 0.6″ arc in diameter. A possible model of the source is one in which this compact object supplies relativistic electrons to the main radio-emitting region, which is coextensive with the distribution of H1 in the centre of the galaxy. The electrons are confined to this region by magnetohydrodynamic waves self-generated by the electrons where the density of H1 becomes sufficiently low. The region has a high dust content and also a high energy density in starlight, which results in its being a strong infrared source. Inverse Comption scattering of the infarared photons by the electrons responsible for the radio emission can produce the observed X-ray emission from the direction of the source. The radiation pressure of the starlight on the dust will also be important dynamically, and may explain the observed filamentary structure along the minor axis of the galaxy. (auth)

4247 X-RAY SPECTRUM OF CYGNUS-A. Longair, M. S. (Cambridge Univ., Eng.); Willmore, A. P. Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 479-490(Sep 1974).

The X-ray source 2U 1957 + 40 is shown from observations with the Copernicus X-ray instrument to be associated with the powerful radiogalaxy Cygnus A. The angular size of the source is found to be less than 10′ arc, the resolution of the telescope for these observations. The spectrum can be fitted by a power law of slope 1.3 ± 0.6 or by thermal bremsstrahlung at a temperature ≥ 5 keV. The low energy cut-off corresponds to a neutral hydrogen column density of $(5.5 \pm 1.6) \times 10^{21}$ cm^{-2}, which may arise from absorption within the Galaxy. The total emission (for a Hubble constant of 50 km s^{-1} Mpc^{-1}) is found to be $(2.3 \pm 0.8) \times 10^{45}$ erg s^{-1}, which is similar to the emission in the radio or optical bands. Various emission mechanisms are considered, and it is shown that synchrotron or inverse Compton radiation from the radio components or a hypothetical halo can be excluded. Thermal bremsstrahlung from a cloud of intergalactic gas is a possible process, which would make 2U 1957 + 40 similar to the other X-ray cluster sources. The kinetic pressure of this gas is sufficient to contain the radio components. Processes occurring in the nucleus of the galaxy are an alternative possibility, however, and it appears that a final determination of the emission process requires high resolution X-ray studies of the structure of the source. (auth)

4248 RADIO RECOMBINATION LINES FROM CARBON AND POSSIBLY HEAVIER ELEMENTS. Pedlar, A.; Hart, L. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng). Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 577-589(Sep 1974).

The 166 α transition (λ 21 cm) has been observed with high sensitivity in the directions of the H II regions NGC 2024, W3A and Orion A. Recombination lines from low-temperature hydrogen, carbon and possibly heavier elements are detected. (auth)

4249 STROEMGREN FOUR-COLOUR OBSERVATIONS OF CYGNUS X-1 AND HERCULES X-1. Hilditch, R. W. (St. Andrews Univ., Scotland); Hill, G. Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 543-549(Sep 1974).

Photometric observations, on the uvby system, of these two X-ray binaries are presented. For Cyg X-1, there are no colour variations with orbital phase. From the derived intrinsic colours of $(b-y)_0 = -0.119$m, $(c_1)_0 = -0.195$m, $(m_1)_0 = +0.092$m, it is suggested that a T_{eff} ~33,000 K and log g ~3.3 may be assigned to the primary component and that an ultraviolet continuum excess Δ_c ~0.06m is present which may arise from an accretion disk surrounding the invisible secondary component. For HZ Her, the existence of a very strong ultraviolet continuum is readily confirmed. The variations of the (u-b) colour index with orbitial phase are as great as the V magnitude variations, amounting to 1.7m between maximum light (phase 0.50) and phase 0.90. (auth)

4250 OBSERVATIONS OF RADIO SOURCES WITH AN INTERFEROMETER OF 24 km BASELINE. IV. The Angular Structures at 408 and 610 MHz of 30 Quasars with Steep Radio Spectra. Wilinson, P. N.; Richards, P. J.; Bowden T. N. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 515-531(Sep 1974).

The angular structures, measured at 408 and 610 MHz with maximum resolving powers of 1.5″ arc and 1.0″ arc, of 30 quasars with steep radio spectra are presented. There is evidence that all the sources have at least two spatially separated emitting regions and that the general morphology of the double sources is similar to that of the doubles studied in the earlier papers in this series. For many of these quasars, however, the 408 MHz observations delineate the whole of the components, which are usually 5″ arc in size, and this contrasts with the results in the earlier papers, where the interferometers were usually only sensitive to higher brightness regions in the components of radio galaxies and unidentified sources. The resolution of the 610 MHz observations is just sufficient to reveal that there is also smaller scale structure in the components of these quasars. Comparison with other interferometer observations, primarily at 2695 MHz, shows that two sources definitely show frequency-dependent structure, but no significant change with frequency was detected in any of the other sources, most of which are D1 in Miley's classification. A comparison of the individual components in D1 quasars shows that their radio properties are similar to those of the extended radio galaxies studied by Mackey. (auth)

4251 POSSIBILITY OF A GRAVITATIONAL EFFECT IN THE SPECTRA OF QUASI-STELLAR OBJECTS. I. Durgapal, M. C. (Univ. of Jodhpur, India). J. Phys., A (London); 7: No. 13, 1676-1680(1 Sep 1974).

In quasi-stellar objects the redshifts of spectral lines are generally different in absorption and emission. The possibility that the redshift difference in most cases is gravitational is not ruled out. The effect can be seen in a Fowler–Hoyle type model (Nature (London); 213:373-4 (1967)). There exists the possibility that most (but not all) of lines with $Z_{ab} < Z_{em}$ might be associated with quasi-stellar objects. (auth)

4252 OPTICAL PULSATIONS FROM THE HZ HERCULIS–HERCULES X–1 SYSTEM. Groth, E.J. (Joseph Henry Laboratories, Physics Department, Princeton University). Astrophys. J. 192: No. 2, 517-523 (1 Sept 1974).

Definite optical pulsation ($\sim$0.2% rms modulation) have been observed from the HZ Her–Her X–1 system. These pulsations occurred near the 1.24–s period of the X–ray source. There is also some indication of pulsation at one–half and twice this period. Correlations of the optical pulsation with the 1.7–day and 35–day X–ray cycles are discussed and locations of the optical emitting regions are tentatively identified. (auth)

4253 ANALYTIC PULSAR MODELS. Adams, R.C.; Cohen, J.M. (Physics Department, University of Pennsylvania, Philadelphia); Adler, R.J.; Sheffield, C. Astrophys. J. 192: No. 2, 525-528 (1 Sept 1974).

An analytic solution to Einstein's field equations is given. This analytic model of a uniform denisty slowly rotating neutron star can describe differentially as well as uniformly rotating stars. (auth)

4254 RADIO RECOMBINATION LINES AT A WAVELENGTH OF 78 CENTIMETERS. Gordon, K.J.; Gordon, C.P. (Hampshire College, Amherst, Massachusetts); Lockman, F.J. Astrophys. J. 192: No. 2, 337-342 (1 Sept 1974).

Galactic H II regions and supernova remnants were observed in the 257α and 323β recombination lines near 386 MHz($\lambda \simeq 78$ cm) with the NRAO 300–foot (91–m) telescope. The H257α line was found in M17, W43 (both +45 and +98 km s^{-1} features), W51 (G49.0–0.2), and the North America and Rosette nebulae. In addition, W51 displays C 257α. The β transition was not detected in any source. Line emission from the diffuse interstellar medium may be important at this frequency, apparently contributing to the H 257 α profile toward M 17, and possibly, toward W43 and W51. Except for M17, the line widths and velocities calculated from our data are consistent with measurements taken at higher frequencies. (auth)

4255 COMPACT RADIO STRUCTURE IN THE H II REGION G351.6–1.3. Broderick, J.J. (National Astronomy and Ionosphere Center, Arecibo, Puerto Rico); Brown, R.L. Astrophys. J. 192: No. 2, 343-346 (1 Sept 1974).

Interferometer observations of G351.6–1.3 reveal the presence of a compact source of radio emission at both 11.1 and 3.7 cm that contributes approximately one–fourth of the total nebular flux density at these wavelengths. The emission measure in this component is $\sim 4.6\times10^{8}$ cm^{-6} pc. The fringe amplitude data are used to show that there exists a radial density gradient in the nebula which peaks at the radio source. The presence of an intense 10–μ source whose position and size agrees with that of the radio component suggests that the near–infrared emission originates in nebular–heated dust. The far–infrared radiation from G351.6–1.3 arises in a region considerably larger than that occupied by the compact structure. (auth)

4256 CO EMISSION ASSOCIATED WITH SHARPLESS H II REGIONS. Dickinson, D.F.; Frogel, J.A.; Persson, S.E. (Center for Astrophysics, Harvard College Observatory). Astrophys. J. 192: No. 2, 347-349 (1 Sept 1974).

Carbon monoxide emission has been found near eight Sharpless H II regions. Its presence appears to depend on the existence of a near–infrared excess (3.5 μ) from the optical nebula. The CO emission is strongly peaked near the H II region itself, and extends considerably beyond. High–resolution line profiles are generally asymmetric, the blue displaying a wing, and are typically $\sim$5 km s^{-1} wide. (auth)

4257 COMPACT INFRARED SOURCES ASSOCIATED WITH SOUTHERN H II REGIONS. Frogel, J.A.; Persson, S.E. (Center for Astrophysics, Harvard College Observatory). Astrophys. J. 192: No. 2, 351-368 (1 Sept 1974).

We have found bright, compact, infrared (1–25 μ) sources associated with 11 galactic H II regions. We present maps showing complex structure at 10 μ in five of these sources. The remaining ones are characterized by a small ($<20''$) core of high surface brightness, with an extended ($\sim1'$) halo. RCW 57/IRS 1, and unresolved source exceptionally bright at 4.8 μ, may be a protostar; a similar object may be embedded in RCW 38/IRS 1. The 1–25 μ luminosity of the single–component source G298.2–0.3 is $2 \times 10^{6}\ L_{\odot}$, the highest of any known H II region. In one source we have been able to detect the exciting star (RCW 38/IRS 2). As is typical for H II regions with infrared counterparts, the energy spectra from 1.2 to 20 μ are at least as steep as $F_\nu \propto \nu^{-3}$, and the observed flux longward of 3.5 μ is in excess, while that shortward of 2.2 μ is deficient when compared with an extrapolation of the radio fluxes. The short–wavelength data show that most of the sources are more heavily reddened than would be expected from interstellar dust alone. For any given source the colors at all wavelengths do not vary significantly with position, implying that the dust which radiates in the 10–20 μ region is well mixed with the ionized gas. Also, we find for this dust a lower limit to the ratio M(H II /M(dust), which, for a reasonable choice of physical parameters, is higher than the interstellar value. The optical depth of a 10–μ absorption feature usually associated with silicates correlates with τ (H_2CO) as determined from radio measurements but not with the visual extinction. We attribute the radio and 10–μ absorption features to cool dust and molecules in circumnebular neutral clouds. The dust in these clouds is probably responsible for the far–infrared radiation, as has been discussed by several authors. For most and possibly for all the H II regions, the 1–25 μ flux can be accounted for by the absorption on dust grains of resonantly trapped Lα photons. We find no evidence that any of this dust markedly affects the ionization structure of the H II regions. (auth)

4258 PHYSICS OF COMPACT NONTHERMAL SOURCES. II. DETERMINATION OF PHYSICAL PARAMETERS. Jones, T.W.; O'Dell, S.L. (Department of Physics, University of California, San Diego); Stein, W.A. Astrophys. J. 192: No. 2, 261-278 (1 Sept 1974).

In Paper I a set of restrictions upon the magnetic field and visible angular size of a canonical nonthermal source (one whose emission is incoherent electron synchrotron) were obtained. The degree of electron anisotropy and magnetic field disordering were left as free parameters. In the present paper these restrictions are applied to the variable compact radio sources 3C 84, 3C 120, 3C 273, 3C 279, 3C 454.3, CTA 102, 3C 446, PKS 2134+ 004, VRO 42.22.01, and OJ 287. The theoretically derived angular sizes for these sources are in reasonable agreement with published VLBI sizes provided that the characteristic pitch angles are not extremely small. The magnetic field strengths determined from the degree of circular polarization are generally compatible with field strengths derived from the self–absorption and synchrotron self–Compton conditions, again provided that the pitch angles are not too small. It is argued that the self–absorption optical depth cannot be much less than unity near the low–frequency turnovers; otherwise, serious discrepancies with observation result. The derived magnetic fields are generally less than the equipartition fields, indicating the sources are matter dominated. When placed at their redshift distances, most of the sources appear to vary with a time scale comparable to the light travel time across the source. However, for 3C 454.3 and CTA 102, time scales much shorter than the light travel time are observed. It is shown that multiple bursts of small canonical sources will not adequately explain this phenomenon unless extreme relativistic effects are included. Alternative explanations are briefly discussed. Conservative upper limits to the distance of VRO 42.22.01 (BL Lac) and OJ 287 based on light travel time arguments are 80 and 500 Mpc, respectively, unless highly relativistic motions are invoked. (auth)

4259 STABILITY OF REISSNER–NORDSTRÖM BLACK HOLES. Moncrief, V. (Department of Mathematics, University of California, Berkeley, California 94720). Phys. Rev. D 10: No. 4, 1057-1059 (15 Aug 1974).

Extending some previous work we here consider the even–parity perturbations of the Reissner–Nordström family of black holes. Gauge–invariant functions of the gravitational and electromagnetic perturbations are defined in terms of the standard Regge–Wheeler expansion functions, and the coupled wave equations obeyed by these quantities are given. The wave equations are decoupled by a simple transformation, and the decoupled equations are shown to admit no unstable normal–model solutions obeying the appropriate boundary conditions. (auth)

4260 NEUTRON STARS IN CLOSE BINARY SYSTEMS. Wheeler, J.C.; McKee, C.F.; Lecar, M. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. Lett. 192: No. 2, L71-L74 (1 Sept 1974).

We calculate the eccentricity induced in a close binary system by a supernova explosion which leaves a neutron star. Tidal circularization may have produced the small observed eccentricity of Her X–1, but the estimated time of circularization is highly uncertain; for Cen X–3 we conclude that if it is a neutron star, there is probably a circularization mechanism presently causing it to spiral into the primary. (auth)

4261 A SEARCH FOR X–RAYS FROM SUPERNOVA 1972e WITH UHURU AND OSO–7. Canizares, C.R.; Neighbours, J.E. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology, Cambridge, Massachusetts); Matilsky, T. Astrophys. J. Lett. 192: No. 2, L61-L63 (1 Sept 1974).

Thirteen observations from 16 months before to two years after maximum light reveal only one possible (3.2 σ) positive result which corresponds to a luminosity of $1.0\pm0.3\times10^{41}$ ergs s^{-1} (3–10 keV) at

45^d before max. The failure to detect any sizable flux contradicts a model by Shklovsky and may constrain that of Colgate and McKee. (auth)

4262 3C236, DA240: THE LARGEST RADIO SOURCES KNOWN. Willis, A. G.; Strom, R. G.; Wilson, A. S. (Sterrewacht, Leiden). Nature (London); 250: No. 5468, 625-630 (23 Aug 1974).

A high-resolution study was made of faint and very extensive radio components associated with the galaxies 3C236 and DA240. Their respective linear dimensions of 5.7 Mpc and 2 Mpc are without precedent. Their properties are compared with those of other radio galaxies, and the consequences for present models of the evolution of these objects are briefly discussed. (auth)

4263 STRUCTURE AND ORIGIN OF RADIO SOURCES WITH VERY STEEP SPECTRA. Slingo, A. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 307-330(Aug 1974).

New observations with the One-Mile radio telescope at 408 MHz and 1407 MHz are presented of 26 radio sources with very steep low-frequency spectra. The contour maps, radio spectra and optical identifications allow a detailed discussion of many of the sources. Two new examples of "head-tail" radio galaxies have been discovered. It is concluded that the steep spectrum sources occur exclusively in rich clusters of galaxies and that many of those previously unidentified are in clusters having $z \sim 0.2$. The spread in physical sizes found is large but not significantly different from that of cluster sources in general. It is argued that these sources have evolved from powerful double radio galaxies, spending 10^9 to 10^{10} yr in the steep spectrum phase, and that the low average expansion velocities imply efficient confinement by a hot cluster medium. Thermal bremsstrahlung from such a medium is probably the cause of the X-ray emission observed from two of the clusters studied. The inverse-Compton effect model is unable to account for the observed X-ray luminosities unless the magnetic fields in the associated radio galaxies are much weaker than the equipartition values. The steep radio spectra are caused by the drain on the electron population resulting from the generation of synchrotron radiation, or in the case of the largest sources by the inverse-Compton collisions of the electrons with photons of the 2.7 K background radiation. (auth)

4264 ACCURATE POSITIONS AND OPTICAL STUDIES IN NINE SOUTHERN PULSAR FIELDS. Vaughn, A. E. (Univ. of Sydney); Disney, M. J.; Nicholson, P. Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 361-369(Aug 1974).

Positions for nine southern pulsars have been measured with the Mills Cross to an accuracy of a few arc seconds. Plates are shown of the regions. A search for optical pulsed emission has been carried out for three of the shortest period pulsars with negative results to a limiting magnitude fainter than $m_v = 20$. The possibility that 0835-40 lies in a cluster is discussed. (auth)

4265 TIDAL INTERACTION AND THE ORBITAL PERIOD OF CEN X-3. Pringle, J. E. (Inst. for Advanced Study, Princeton, NJ). Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 13P-18P (Aug 1974).

The tidal evolution of a close binary system containing a compact object is examined. It is suggested that the observed orbital period change of Cen X-3 on a time scale of 10^4 yr is due to tidal interaction, and that a similar effect may be observable for the source 2U 1700-37/HD 153919. (auth)

4266 RADIO EMISSION FROM HEN 1044. Wright, A. E. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia); Fourikis, N.; Purton, C. R.; Feldman, P. A. Nature (London); 250: No. 5469, 715-716(30 Aug 1974).

The detection of radio emission from the Southern Hemisphere compact emission line object Hen 1044 (He 2-113) is reported. The observations were made at 3.0 and 6.0 cm. using the Parkes CSIRO 64 m. telescope. Beam switching was used to reduce atmospheric effects. At 3.0 cm. a mixer receiver was used with a predetection bandwidth of 500 MHz, and at 6.0 cm. a cryogenically cooled parametric amplifier with a predetection bandwidth of 300 MHz was used. Radio emission was detected at both wavelengths. The flux density determined 3 cm. in August 1973 was 0.24 ± 0.03 Jy and at 6 cm. in October 1973 it was 0.11 ± 0.03 Jy. The object has a stellar appearance, with no obvious surrounding nebulosity, and its optical spectrum is that of a low excitation planetary nebula associated with a cool WC star. Mass outflow is indicated by the presence of P Cygni profiles. These characteristics are suggestive of an embryonic planetary nebula. (UK)

Solar Phenomena

Refer also to abstracts 4167, 4233, 4400, 4415, 4462, and 5125.

4267 (AD-777891) STUDIES OF LARGE AMPLITUDE PLASMA WAVES. Final Report, 14 November 1971-30 September 1973. Flynn, R. W. (University of South Florida, Tampa (USA). Dept. of Physics). 31 Dec 1971. Contract F19628-72-C-0132. 34p. (AFCRL-TR-74-0137). NTIS $3.25.

The report summarizes the accomplishments of the University of South Florida solar plasma group in several areas, namely (1) development of a nonlinear theory of waves in a cold magnetoplasma (2) nonlinear waves in a waterbag plasma (3) attempts at generalization of the foregoing cold plasma theory to finite temperatures. (4) Ion trapping as a stabilization mechanism for the ion-acoustic instability, (5) "swift" acceleration of solar protons, (6) plasma expansion experiment, (7) ion acoustic waves in a density gradient, (8) effects of large-amplitude rf on ion acoustic waves and (9) rf field effects on Langmuir probe characteristics. (auth)

4268 (LA-5590-MS) NEAR INFRARED PHOTOGRAPHY OF THE OUTER CORONA DURING THE 30 JUNE 1973 SOLAR ECLIPSE. Radziemski, L. J. Jr. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1974. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

Near infrared photographs of the solar corona were made at sea level from a ship, Canberra, positioned about 300 miles west of Nouakchett, Mauritania. We obtained polarimetry by taking exposures through HR plane polarizing filters oriented at three successive 60° intervals. Kodak 2424 Aerographic infrared film was used. The pass band of the filter-film combination was about 90 nm centered around 840 nm. The inner corona was occulted by a disk placed 1.5 m in front of an f/2.9, 230-mm-focal-length, Dallmeyer lens. One complete set of frames was obtained which shows changes in streamer structure with changing filter orientation. On the frame with the polaroid's axis of transmission almost parallel to the north solar axis, four outer coronal streamers to the west can be followed out to 11 $R_\odot$, and two broad diffuse streamers to the east to 7 $R_\odot$ where they merge into a single blur. A broad, diffuse illumination is also visible to 15 $R_\odot$ to both east and west. The streamers are extensions of those seen in inner coronal photographs. Photographic photometry shows that the sky background in the wavelength region covered by this experiment was about 1.1×10^{-10} SSB. (auth)

4269 SOLAR LIMB AND DISK CONTINUUM INTENSITIES IN THE WAVE-LENGTH REGION 1450 TO 1950 A. Jordan, C.; Ridgeley, A. (Science Research Council, Abingdon, Eng.). Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 533-541(Sep 1974).

Observations of the intensity of the solar continuum in the wavelength region 1450 to 1950 Å are reported. Measurements of fluxes were made on the disk and across the limb, and have been compared with those predicted by the Bilderberg Continuum Atmosphere and the Harvard Smithsonian Reference Atmosphere. A large discrepancy between the observed fluxes and those predicted by the models is found for the region where $\lambda > 1700$ Å, as reported by other authors. The origin of the continuum (i.e., the photosphere, region of the temperature minimum or chromosphere) as a function of wavelength is deduced from the observed limb-brightening or limb-darkening. There is evidence that continuum emission from material with brightness temperatures less than about 5000 K extends further beyond the limb than predicted by the spherically symmetric homogeneous models. (auth)

4270 SOLAR FLARE PROTON RIGIDITY SPECTRA DEDUCED FROM COSMIC RAY NEUTRON MONITOR OBSERVATIONS. Lockwood, J.A.; Webber, W.R.; Hsieh, L. (Physics Department, University of New Hampshire, Durham, New Hampshire 03824). J. Geophys. Res. 79: No. 28, 4149-4156 (1 Oct 1974).

The solar flare proton rigidity spectra for several flares occurring between 1967 and 1972 have been deduced from the ground level cosmic ray neutron monitor observations. To obtain consistent agreement for all the ground level events (GLE's) analyzed, the specific yield functions of Lockwood and Webber (1967) must be reduced slightly below $P = 1.6$ GV. The typical spectral indices of solar cosmic rays deduced for GLE's vary from 4 to 6 if the differential spectrum is represented by $KP^{-\gamma}$. Only occasionally is the spectrum as steep as 8 or 9. The observed spectral index is independent of the magnitude of the integral solar proton flux above 1 GV. (auth)

4271 ON THE BACKSCATTER INSTABILITY OF SOLAR WIND ALFVÉN WAVES. Cohen, R.H.; Dewar, R.L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). J. Geophys. Res. 79: No. 28, 4174-4178 (1 Oct 1974).

A coherent Alfvén wave propagating along the equilibrium magnetic field is unstable against decay into an Alfvén wave traveling in the opposite direction and a sound wave [Sagdeev and Galeev, 1969]. The stability of incoherent Alfvén waves against this mode decay is considered, assuming that the sound waves are damped. The criterion for stabilizing waves with power spectral density $I_k \propto k^{-n}$ is $N > 1$. The results indicate that solar wind Alfvén waves are stable in the wavelength range considered in Mariner 5 observations, although a mild instability is predicted for longer wavelengths. (auth)

4272 PIONEER 9 PLASMA WAVE AND SOLAR PLASMA MEASUREMENTS FOR THE AUGUST 1972 STORM PERIOD. Scarf, F.L. (Space Sciences Laboratory, TRW Systems Group, Redondo Beach, California 90278); Wolfe, J.H. J. Geophys. Res. 79: No. 28, 4179-4185 (1 Oct 1974).

The solar disturbances of August 1972 produced large–scale solar wind perturbations that were detected by the Pioneer 9 plasma probe, electric field detector, and magnetometer for an extended time period commencing early on August 3. During this 10–day interval the interplanetary plasma parameters at $r \simeq 0.8$ AU varied over unusually wide ranges, so that the conditions for generation of high and low VLF wave levels could be identified fairly readily. We demonstrate that no measurable signals were detected in the broad band electric field channel (sensitive to waves with $f \geq 100$ Hz in the spacecraft frame of reference) unless the proton density was high enough to yield a proton plasma frequency with $f \gtrsim 100$ Hz. The analysis suggests that waves related to ion acoustic oscillations were detected throughout the extended storm period. (auth)

4273 RELATIVE CORONAL ABUNDANCES DERIVED FROM X–RAY OBSERVATIONS. II. NITROGEN, OXYGEN, NEON MAGNESIUM, AND IRON. Walker Jr., A.B.C.; Rugge, H.R.; Weiss, K. (Space Physics Laboratory, The Aerospace Corporation, El Segundo, California). Astrophys. J. 192: No. 1, 169-180 (15 Aug 1974).

We have observed the coronal spectrum between 8.5 and 25 Å with the crystal spectrometer on the OV1–10 satellite. The measured fluxes of the resonance lines O VII, O VIII, Ne IX, Ne X, and Mg XI have been used to construct a model of the coronal emission measure between 1 and 6×10^{6}°K. This model has been used to determine the relative abundances of O, Ne, and Mg. The relative abundances of N and Fe were also computed using the observed intensities of the resonance lines of N VII and Fe XVII. The relative abundances found are (A_{Mg} has been arbitrarily set equal to 30×10^{-6}) $A_N = 90\times10^{6}$, $A_O=700\times10^{-6}$, $A_{Ne}=54\times10^{-6}$, $A_{Mg}=30\times10^{-6}$, and $A_{Fe}=40\times10^{-6}$. These abundances are in good agreement with photospheric abundances, but the O and Ne abundances are higher than those found for these elements in previous studies of the transition region. We have used the coronal model based on the line fluxes to calculate the expected continuum fluxes, and compared these calculated fluxes with the observed continuum fluxes. The agreement between calculated and observed continuum fluxes is good between ~8.5 and ~14 Å; however, the calculated flux is too small by a factor of 2 above 14 Å. We believe this disagreement is caused by the inclusion of a number of weak lines in the observed continuum flux. (auth)

4274 THEORETICAL HELIUM I EMISSION–LINE INTENSITIES FOR QUIESCENT PROMINENCES. Heasley, J.N.; Mihalas, D.; Poland, A.I. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado). Astrophys. J. 192: No. 1, 181-192 (15 Aug 1974).

Self–consistent solutions of the combined statistical equilibrium and transfer equations have been carried out for a rather complete multilevel multi–ion model helium atom in model quiescent prominences. The excitation and ionization of both He I and He II were considered simultaneously, and detailed calculations of the radiative transfer in the resonance lines and ground–state continua of both these ions were made, allowing for the effects of overlapping hydrogen transitions. A large number of excited states have been included in the computation, so that a fairly comprehensive set of predicted subordinate line intensities are now available for comparison with observation. A preliminary comparison of the predicted values with published singlet/triplet ratio observations shows good agreement for all the pairs of lines considered. (auth)

4275 SATELLITE LINE SPECTRA FROM LASER–PRODUCED PLASMAS. Feldman, U.; Doschek, G.A. (E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, D.C.); Nagel, D.J.; Cowan, R.D.; Whitlock, R.R. Astrophys. J. 192: No. 1, 213-220 (15 Aug 1974).

We have obtained X–ray spectra of high–temperature plasmas produced by the 100 GW glass laser at the Naval Research Laboratory. In this paper, we discuss the satellite lines of hydrogen–like and helium–like ions, observed in the 2–12 Å region for elements ranging from sodium through titanium. The satellite lines are due to transitions of the type, $1snl-2pnl$, $1s^2nl-1s2pnl$, $n=2,3$; and $1s^22l-1s2l3p$. Physical conditions in the plasma are discussed in terms of relative line–intensity ratios and line profiles. (auth)

4276 THE ENERGY SPECTRUM OF 0.16 TO 2 MeV ELECTRONS DURING SOLAR QUIET TIMES. Hurford, G.J.; Mewaldt, R.A.; Stone, E.C.; Vogt, R.E. (Division of Physics, Mathematics, and Astronomy, California Institute of Technology, Pasadena, California). Astrophys. J. 192: No. 2, 541-546 (1 Sept 1974).

New observations of the quiet–time energy spectrum of 0.16 to 2 MeV electrons have been made with the Caltech Electrons/Isotope Spectrometer which was launched on IMP–7 in September 1972. Earlier measurements of quiet–time electrons in this energy range by other groups have resulted in spectra differing by more than an order of magnitude in intensity. We find a minimum quiet–time flux level somewhat lower than the lowest previously reported spectra and consistent with an extrapolation of the spectrum measured at higher energies. A galactic secondary source of knock–on electrons is consistent with our results and with independent studies of the interstellar spectra of cosmic–ray nuclei provided that solar modulation does not suppress the 0.16–2 MeV electron flux by more than a factor of ~3. Although not required, other recently suggested sources may also contribute to the observed fluxes. (auth)

4277 COSMIC-RAY BURSTS IN NORIL'SK ON 24 JANUARY AND 1 SEPTEMBER 1971. Dorman, L. I.; Palamarchuk, A. V.; Karpov, V. P.; Kurchenko, Yu. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 125-126(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 151(1974).

The temporal variations of the intensity of cosmic rays of the neutron component, of the riometer at a frequency of 32 MHz, and of the H component of the geomagnetic field are shown for 24-25 January. The variations are also shown for a burst beginning on Sept. 1, 1971. It is pointed out that these bursts have a different rise and decrease time because of different solar particle propagation conditions in interplanetary space. (MHR)

4278 IDENTIFICATION OF TANGENTIAL AND CONTACT DISCONTINUITIES FROM MEASUREMENTS IN THE SOLAR WIND. Ivanov, K. G. Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 5-8(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 8-12(1974).

The problem of identifying tangential discontinuities in the solar wind is discussed, and a method is proposed for separating convective discontinuities. An analysis of 32 discontinuities, identified earlier as tangential, leads to the conclusion that they contain a considerable number of rotational discontinuities and makes it possible to identify several tangential and contact discontinuities. (auth)

4279 IDENTIFICATION OF THE INTERPLANETARY MAGNETIC FIELD FROM THE PLANETARY K_p-INDEX FOR 1932–1972. Afanas'eva, V. A.; Evdokimova, L. V.; Mikerina, N. V.; Ivanov, K. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 9-12(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 13-17(1974).

The statistical patterns of the relative distribution of the northern and southern normal components in the positive and negative sectors of the interplanetary magnetic field are investigated for the period 1932–1972. The relation between flares and the change in direction of the radial component of the interplanetary magnetic field is examined. (auth)

4280 SOLAR PROTON FLARES AND THE SECTOR STRUCTURE OF THE INTERPLANETARY MAGNETIC FIELD. Obridko, V. N.; Mansurov, S. M.; Mansurova, L. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 1-4(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 3-7(1974).

The statistical relation between the position of proton flares on the sun and the sector structure of the interplanetary magnetic field is investigated. The facts that flare activity is concentrated at the boundaries of the sector structure and that flares predominate in the leading part of a sector are confirmed. The results obtained suggest the probability that solar-wind velocity varies with the phase of the solar activity cycle. (auth)

4281 FORMATION OF HOLES IN THE SOLAR CORONA. Glencross, W. M. (Mullard Space Science Lab., Dorking, Eng.). Nature (London); 250: No. 5469, 717-719(30 Aug 1974).

It is stated that amongst interesting features observed in soft x-ray spectroheliograms obtained in Skylab and rocket flights are extensive regions from which emission is very low. These long, but relatively narrow, "coronal holes" can stretch much of the way across the solar disk in an approximately N–S direction, and the underlying photosphere and chromosphere are relatively featureless and show a low magnetic flux density. The magnetic structure of these lower levels is not untypical of other quiet regions on the Sun, suggesting that the magnetic configuration associated with the holes might not have emerged from the solar surfaces with any particularly unusual geometry, but that this might have developed later due to some rearrangement within the solar atmosphere. The spectroheliograms indicate the existence of long magnetic arch structures in the solar atmosphere, and it is thought that these are produced by merging of smaller structures by cross-connection of field lines, resulting in a reduction of the stored magnetic energy. The way in which this proceeds and leads to "coronal holes" is discussed. In addition to the "coronal holes" soft x-ray spectroheliograms show regions of low emission that form along the path of dark filaments, and such structures could be closely related to "coronal holes". (UK)

4282 SPECTROSCOPY OF PLASMAS CARRYING SOUND WAVES. I. Spectral Intensities. McWhirter, R. W. P. (Science Research Council, Abingdon, Eng.); Wilson, R. J. Phys., B (London); 7: No. 12, 1588-1601(21 Aug 1974).

In this paper the theory is developed for the intensities of spectral lines from a plasma in which a sound wave is propagating. It is shown that the presence of the sound waves causes the ionization balance to be altered from the quiescent plasma condition, and the effect on excitation is also considered. The treatment covers isothermal and adiabatic sound waves in three plasma conditions: (i) Uniform high-density plasma in local thermodynamic equilibrium (LTE). (ii) Uniform low-density plasma (non-LTE). (iii) Low-density plasma of uniform pressure and a temperature gradient. The results show that the presence of a sound wave can cause quite large changes in the ionization balance depending on the magnitude and frequency of the waves as well as the atomic parameters. The intensities are modulated with the same frequency as the waves, and the time- or space-averaged intensities can also be significantly modified. In the case with the temperature gradient the counter-acting effects of ionization balance and excitation are shown to reduce the extent to which the time-averaged intensities are changed. The theory has been developed because of its possible application to the interpretation of the solar spectrum arising from the transition region between the chromosphere and corona where one of the proposed mechanisms for heating the corona requires propagating sound waves. Related effects may be observable in the laboratory, particularly in high-density plasmas such as produced in a spectroscopic arc. (auth)

4283 CALIBRATION OF THE PHOTOELECTRIC MEASUREMENTS OF MAGNETIC FIELD. Kotov, V. A. Izv. Krym. Astrofiz. Observ.; 47: 14-25(1973). (In Russian).

Magnetic field records for the same sunspot made using Crimean and Fraunhofer Institut magnetographs were found to be in a great discrepancy. With application of two very different calibrations this resulted in the quite different data concerning the magnetic configuration of the spot. The exit slit geometry proposed by Semel was employed at Crimea to measure the displacements $\Delta\lambda_H$ of line profile observed with a quarter-wave analyzer. The observations show that for high fields the longitudinal component $H_\parallel$ determined from $\Delta\lambda_H$ is essentially diminished. But $\Delta\lambda_H$ represents well $H_\parallel$ when it is less than 250 G, so this method should be used to get satisfactory calibration for weak fields. (auth)

4284 PROPERTIES OF LARGE-SCALE VELOCITY FIELDS IN THE QUIET SOLAR ATMOSPHERE. Gopasyuk, S. I.; Tsap, T. T. Izv. Krym. Astrofiz. Observ.; 47: 26-35(1973). (In Russian).

The large-scale velocity fields in the quiet solar atmosphere is studied. Observations of the line-of-sight velocities and magnetic fields at the center of the disk and near the poles were made with the double-magnetograph. The following lines were used: H_α, K_3 Ca II, H_β, H_γ, H_δ, λ5184 Å Mg I, λ4227 Å Ca I, D_1 Na I, λ6103 Å Ca I, λ5250 Å Fe I. It is found that the mean dimensions of the velocity cells change with the height. The smallest mean dimension of the velocity cells is observed at the level of formation of the D_1 Na I–λ5184 Å Mg I lines. The position of the maximum longitudinal field strength within a magnetic hill coincides statistically with the zero-line of the line-of-sight velocity at the level of formation of the D_1 Na I to λ5184 Å Mg I lines as well as on the other ones. The velocities within each cell with upward or downward motions have cosinusal distribution. The horizontal and vertical motions have the same velocities in the photosphere as well as in the chromosphere. The horizontal velocities increase with the height. The ratio of the mean horizontal velocities in the H_α line to the horizontal velocities in the λ5250 Å Fe I line is 4–5. The large-scale velocities change with the cycle of the solar activity. The observational properties of the velocity cells suggest that they could be due to the gravity wave motions in the solar atmosphere. (auth)

4285 PHYSICAL CONDITIONS IN TWO REGIONS OF THE SOLAR CORONA ON MARCH 7, 1970. Babin, A. N.; Steshenko, N. V. Izv. Krym. Astrofiz. Observ.; 47: 36-48(1973). (In Russian).

The spectra of corona were obtained with two fast spectrographs during totality (USSR expedition near Miahuatlan, Oaxaca, Mexico). Spectrograph slits were oriented approximately in the radial direction. Spectrograph of visible spectrum (λλ 4800–6600 Å, 42 Å/mm, f/1,25) was used to observe the bright corona region ($P_{\text{heliocentr}} \approx 210°$), ultraviolet spectrograph (λλ 3250–4250 Å, 36 Å/mm, f/1,25)—for observation of weak corona ($P_{\text{heliocentr}} \approx 225°$). The distributions of electron density in both regions as well as number density of Fe X, Fe XIV ions in the bright corona and Fe XIII in the weak one were obtained. Determination of the iron abundance was made from the equivalent widths of the green coronal line λ 5303 Å at distances 0,5–0,8 $R_\odot$ from the solar limb, $N(\text{Fe})/N(\text{H}) \approx 7{,}2 \cdot 10^{-5}$. Derived from the λ 3388 Å line intensities overabundance of iron ($N(\text{Fe})/N(\text{H}) \approx 2.2 \cdot 10^{-4}$) within weak corona may be attributed to ray structure of the corona. In this case the diameters of rays are approximately equal to interray spaces. The λ 5303 Å line shows the strong local motions in the corona. At the height of ~0,6 $R_\odot$ the line-of-sight velocity is ~20 km/sec. (auth)

4286 BRIGHTNESS DISTRIBUTION IN SPECTROHELIOGRAMS TAKEN IN SOME SOLAR UV SPECTRUM LINES. Dubov, E. E.; Kartashova, L. G. Izv. Krym. Astrofiz. Observ.; 47: 49-57(1973). (In Russian).

The brightness distributions for quiet and slightly disturbed solar disc regions in spectroheliograms (SHG) taken by means of satellite OSO-IV in EUV lines of some ions are compared. The so called first group ions (N III, O IV, O VI) emit mainly in chromosphere–corona transition zone, the second group ions are essentionally coronal. It was found that brightness distributions for quiet and slightly disturbed regions of the solar disk are rather similar for various ions in the same group, but they are quite different for the ions from different groups. The statistical confidence of this difference corresponds to the significance level of 0.05. Correlation analysis confirms this conclusion. For some places on SHG taken in the 1032 Å line of O VI (the first group) there are coincidences of bright and dark spots locations with that in SHG's taken in coronal type lines of second group brightness distribution. There is also an unusually great amount of bright details in SHG taken in Lyman continuum near 800 Å. The results obtained correspond to the predictions of the model of chromosphere and of chromosphere–corona transition zone given earlier. (auth)

4287 CIRCULAR POLARIZED EMISSION OVER THE BIPOLAR GROUP OF SUNSPOTS AT 8-MM WAVELENGTH. Ephanov, V. A.; Moiseev, I. G. Izv. Krym. Astrofiz. Observ.; 47: 58-63(1973). (In Russian).

The results of investigation of the circular polarized component of local source at 8-mm are presented. The source was situated over the bipolar group of sunspots and its transit through the sun was observed. The circular polarized component intensity variation has a maximum over the following part of the group when it is situated by about 25 to 30 degrees to the east from the central meridian and over the preceding part by equal distances to the west. This fact has been thought of as an indication of the magnetic field direction of the group. The percentage of maximum circular polarization is not greater than 3%. (auth)

4288 CHANGES OF POLARIZATION DURING SOLAR RADIO BURSTS OBSERVED ON OCTOBER 29, 1968 AT 3.15 CM. Eryushev, N. N.; Tsvetkov, L. I. Izv. Krym. Astrofiz. Observ.;47: 64-70(1973). (In Russian).

Variation of the degree of circular polarization of solar radio bursts at 3.15 cm with time are considered. The observations under consideration were carried out with the 22-meter radio telescope at the Crimean observatory on October 29, 1968. There was found that the radio bursts were distributed in three separate groups. The general behavior of the degree of polarization for two of these groups is similar to a quasiperiodical process; in one case—a rising type, in the other one a damping type. The degree of polarization changes markedly from burst to burst, independently from their intensity, as well as during bursts itself. A relation between the polarization degree of radio emission and the hardness of x-ray emission during solar flares were found. (auth)

4289 FORECAST OF THE SOLAR RADIO BURSTS. Yurovskii, Yu. F.; Gerasimov, V. P. Izv. Krym. Astrofiz. Observ.; 47: 71-78(1973). (In Russian).

The statistical analysis of the solar emission at 2800 MHz during the period of Jan, 1967–Sept, 1968 was made. There was found a statistical law, by means of which it is possible to predict the number of radio bursts, if the value of the solar radio flux is known. The dependence between intensity of bursts and solar radio flux was studied. It was shown that prognostication of the proton events is impossible only on the basis of the information about the solar flux at single frequency. (auth)

4290 RELATIVE LOCATION OF REGIONS OF NOISE-STORM EMISSION. Yurovskaya, L. I. Izv. Krym. Astrofiz. Observ.; 47: 79-82(1973). (In Russian).

Three solar eclipses were observed at wavelength 1.37 m. It was possible to show that the regions of the burst-emission were large and were located nearer to solar east limb than regions of noise-storms. Very good correlations between magnetic field of the leading parts of solar spot groups and fluxes of radio-emission of noises were found. At one of the considered regions a good correlation between the burst-intensity and magnetic flux of the rear part of solar spot group was found too. (auth)

4291 VERTICAL DISTRIBUTION OF MAGNETIC FIELD IN THE BRIGHT REGION OF THE SUNSPOT PENUMBRA. II. Guseinov, M. D. Izv. Krym. Astrofiz. Observ.; 47: 7-13(1973). (In Russian).

Magnetic field strength in the chromosphere above the bright formation of common penumbra of the spot group was measured in the central parts of the H_α, H_β, H_γ, and Ca II H lines, and in some strong lines of Fe I, Ca I, Na I, Mg I, Ti II, Sr II also. Zeeman splittings were measured in the polarization spectrogram obtained with the echellette spectrograph of the Crimean solar tower telescope. The height behavior of the field strength was studied. At first the field strength increases with height from the value of ≈600 gs at the photosphere–chromosphere boundary (the vertical gradient with height $\Delta H/\Delta h = +0.75$ gs/km), and amounts to $H = 2000$ gs at the level where the central part of H_γ is formed. After that the field weakens with height, relatively rapidly of the levels of the H_β and Ca II H lines ($\Delta H/\Delta h = -1.10$ gs/km) and some what slowly at higher levels ($\Delta H/\Delta h = -0.37$ gs/km). The field is about 400 gs at the level of H_α. Possible reasons of the field intensification observed above the bright region in the layers associated with formation of central parts of H_γ are discussed. (auth)

4292 TIME VARIATIONS OF CHROMOSPHERIC NETWORK. Tsap, T. T.; Laba, I. S. Izv. Krym. Astrofiz. Observ.; 48: 73-77 (1973). (In Russian).

Time variations of the chromospheric network are studied using K_{232} spectroheliograms. It is found that the brightness of chromospheric network at the center of the sun and at the northern and southern poles changes with the cycle of the solar activity. The brightness of knots of the chromospheric network increases with the solar activity. During two last solar cycles the brightness of the chromospheric network at the northern pole was a little larger than that at the southern pole. In most cases the brightness of the chromospheric network at the center of the sun and at N- and S-poles changes synchronously. It is suggested that the behavior of the chromospheric network is closely connected with the changes of the general magnetic field of the sun. (auth)

4293 QUASIPERIODIC FLUCTUATIONS OF THE SOLAR RADIO BURSTS INTENSITY AT THE 3.15 CM. Eryushev, N. N.; Tsvetkov, L. I. Izv. Krym. Astrofiz. Observ.; 48: 85-92(1973). (In Russian).

The quasiperiodic variations of intensity and polarization of three solar radio bursts are investigated. Oscillations of intensity with the period from 6 to 320 sec are detected. The amplitude of the oscillations of the intensity is in the range ±7–±50% of the average level. (auth)

4294 OBSERVATION OF SOLAR ACTIVE REGIONS AT 1.35, 1.76, AND 8 mm. Efanov, V. A.; Kulikov, Yu. Yu.; Moiseev, I. G.; Fedoseev, L. I. Izv. Krym. Astrofiz. Observ., 48: 93-97 (1973). (In Russian).

The results of observations of radio emission of solar active region at 1.35, 1.76, and 8 mm with the 22 m radio telescope of the Crimean Astrophysical Observatory are given. The emission of active regions in the range from 1.2 mm to 17 mm are compared with the conclusion that the radio emission of active regions at 1.2 to 4 mm is of thermal origin (optically thick). (auth)

4295 ABUNDANCES IN THE SOLAR CORONA. Olthof, H. (Univ. of Groningen, Netherlands). pp 321-325 of Atoms and Molecules in Astrophysics. Carson, T. R. (ed.). New York; Academic Press, Inc. (1972).

From 12th session of Scottish universities summer school in physics atoms and molecules in astrophysics; Stirling, UK (Aug 1971). See CONF-710859-.

A short description is given of a new analysis of the coronal line spectrum. This analysis is based on the observation of the visual line spectrum observed during the eclipse of May 1965. Relative coronal abundances, ionization potentials of the lines, and the expected strong infrared lines are discussed. (JFP)

4296 ABUNDANCES OF THE ELEMENTS. Williams, P. M.; Edmunds, M. G. (Cambridge Univ., Eng.). Sci. Progr. (Oxford); 61: No. 243, 323-347(1974).

The last decade has seen very considerable progress in the measurement and interpretation of the abundance of the elements. While the Apollo missions have given direct access to lunar material, improvements in basic spectroscopic data and understanding of the solar atmosphere have led to significantly more reliable solar abundance determinations. The observations are being used, with meteoritic and terrestrial abundances, to test theories of the origin of the elements and the formation and history of the solar system. The introduction of high speed computers has led to the first realistic models of stars' atmospheres, and the accurate interpretation of stellar spectra. Stars' compositions give otherwise unobtainable information about their structure and evolution, particularly when evidence is seen of radioactive elements which must have been made in the stars' interiors. The comparison of stellar compositions with their ages and motion in space has told a great deal about the history of the galaxy. New observational techniques are now giving the first real information on the compositions of other galaxies, and quasars. (auth)

4297 PRELIMINARY EPOCHS OF THE MAXIMA AND MINIMA OF THE EIGHTY-YEAR SUNSPOT CYCLE. Hartmann, R. (Univ., Frankfurt am Main). Mitt. Astron. Ges.; No. 34, 116-122 (1973). (In German).

From proceedings of the astronomical society; Oberkochen, Germany (24 Apr 1973).

For the time after 1610 the epochs of the maxima and minima of the eighty-year sunspot cycle can be directly determined on the basis of solar observations. For the time before 1610 another approach has to be employed. Such an approach is provided by a certain correlation between the frequency of aurora borealis phenomena and the frequency of sunspots. The methods used by various authors in their investigation of aurora borealis data are discussed. Data concerning the maxima and minima of the eighty-year sunspot cycle during the time after 350 A.D. are presented in tables. (IAA)

4298 RADIATION ATTENUATION OF ACOUSTIC WAVES AT THE EXIT FROM THE OPTICAL THICK LAYERS OF THE SOLAR ATMOSPHERE. Ulmschneider, P. (Univ., Wuerzburg, Ger.). Mitt. Astron. Ges.; No. 34, 111-114(1973). (In German).

From proceedings of the astronomical society; Oberkochen, Germany (24 Apr 1973).

The temperature of a theoretical chromospheric model as a function of the altitude is considered. It is found that in a determination of the chromospheric temperature characteristics the radiation attenuation of the acoustic waves is a very important factor. A wave loses about 90% of its energy before it reaches an altitude of 200 km in the Harvard Smithsonian reference atmosphere. A computation which provides an exact description of the acoustic waves and the characteristics of the radiation attenuation is discussed. (IAA)

4299 FIRST SOLAR OBSERVATIONS WITH THE EFFELSBERGER 100-M TELESCOPE AT A WAVELENGTH OF 2.8 cm. Fuerst, E.; Hirth, W. (Max-Planck-Institut fuer Radioastronomie, Bonn). Mitt. Astron. Ges.; No. 34, 102-106(1973). (In German).

From proceedings of the astronomical society; Oberkochen, Germany (24 Apr 1973).

A data field of about 4000 points with approximately 1200 independent points of measurement on the solar disk was obtained. A contour-line picture of the Sun is presented. The picture shows regions with a very high activity level and depression zones. A Fraunhofer map obtained on the same day as the contour-line picture is also provided. An analysis of two of the active regions was conducted. It was found that each of these regions is composed of two components. (IAA)

4300 POLAR FIELDS OF THE SUN. Rossbach, M.; Woehl, H. (Univ., Goettingen, Ger.). Sterne Weltraum; 13: 157-160 (May 1974). (In German).

Intense magnetic fields in sunspots were first discovered by Hale in 1908. Information concerning the general magnetic field of the Sun was obtained in studies conducted with an instrument based on an electrooptical approach. Changes in the polarity of the polar fields were observed during 1957 and 1958. Recent measurements of solar magnetic fields are discussed, giving particular attention to possible instrumental error sources. Computer-controlled measurements will provide more data for the study of solar magnetic fields. The theoretical significance of the experimental studies is also considered. (IAA)

Galaxies

Refer also to abstracts 4166, 4246, 4247, 4262, 4263, 4346, 4349, 4350, and 4500.

4301 (N-74-21429) STUDY OF POSSIBLE MODELS FOR BALMER EMISSION LINE REGIONS IN SEYFERT GALAXIES.

Adams, W. M. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Dec 1973. 90p. (NASA-CR-137431; SU-IPR-553). NTIS $7.50.

Two unexplained phenomena exhibited by the Balmer emission lines in Seyfert galaxies, their unique profile structure, and their anomalous intensity ratios are examined. Models of three proposed mechanisms for explaining the broad wings found on the Balmer lines are presented: (1) a uniform medium in which self-absorption of allowed lines increases their escape path length, thus increasing the probability of their being electron scattered so as to account for the wings; (2) the line wings are formed in a separate region with high velocity dispersion; and (3) the lines with wings are formed in a separate region where the electron optical depth is greater, thus creating the wings by electron scattering. The evidence favors the third possibility. A brief review of the results of basic radiative recombination theory is presented followed by an investigation of the appropriateness of using a Maxwellian electron distribution function in collisional excitation calculations. It is determined that under some conditions this distribution function may become significantly non-Maxwellian. (auth)

4302 (N-74-21434) RESEARCH ON INFRARED ASTROPHYSICS AND X RAY AND XUV ASTRONOMY. Semiannual Status Report, 1 October 1973–30 March 1974. (California Inst. of Tech., Pasadena (USA)). 11 Apr 1974. 17p. (NASA-CR-137428). NTIS $4.00.

The infrared research was divided into two related subjects, observations at wavelengths less than 34 microns and millimeter wavelength observations. A new complex of infrared sources in the Orion Nebula observed along with a broad range of galactic and extragalactic objects. The Comet Kohoutek was measured in the 1 to 20 micron wavelength region and its thermal properties agreed closely with those of Comet Ikeya-Seki. Combined infrared and photoelectric studies of the Makarian galaxies showed them to have a composite spectrum with a large emission feature in the far infrared. The development of one millimeter photometry and composited bolometers is described. A technique of reconstructing two dimensional surface brightness distributions with appropriate errors from individual strip scans was developed. Model parameters were determined by fitting data in nonlinear systems. Results show spectral parameter uncertainties are underestimated or incorrectly evaluated in most studies. (auth)

4303 STUDIES OF RICH CLUSTERS OF GALAXIES. II. The Structure and Luminosity Function of the Cluster. Austin, T. B.; Peach, J. V. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 591-602(Sep 1974).

Magnitudes have been measured by photographic photometry for galaxies within 5 arcim of the centre of the very rich cluster A1413. The differential luminosity function shows a maximum at an absolute total V magnitude of -21.30. The absolute magnitude difference between this and the brightest cluster member is 3.59, which is closely consistent with the correlation of Bautz and Abell (Astrophys. J.; 184: 709 (1973)) between this parameter and cluster richness and form type. There is a significant difference between the distributions of the bright and faint galaxies; the former have a distribution consistent with spherical symmetry, while the fainter galaxies show a prolate distribution aligned with the major axis of the brightest cluster member. Counts in the field of the cluster show that this effect extends over most of the cluster volume. (auth)

4304 ALIGNMENT OF INTERSTELLAR DUST CLOUDS. Hopper, P. B.; Disney, M. J. (Australian National Univ., Camberra). Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 639-650 (Sep 1974).

The alignments of a large sample of dense dust clouds have been analysed. It is concluded that they have a generally sheet-like form, with the short axes directed toward the galactic pole. The evidence for any correlation between the cloud alignments and the magnetic field is weak. (auth)

4305 LOW FREQUENCY RECOMBINATION LINES FROM SOUTHERN NEBULAE. Batty, M. J. (Univ. of Sydney). Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 37P-44P(Sep 1974).

Hydrogen recombination line emission from the 252α transition near 408 MHz has been detected in the direction of five southern galactic H II regions; RCW 38, RCW 49, RCW 53 (the Carina nebula), G305.3 + 0.2 and M17. The observed line widths indicate line formation in regions having electron densities of $\lesssim 10^2$ cm^{-3}, in general agreement with observations of other sources at low frequencies. (auth)

4306 CH AND CH$^+$ IN INTERSTELLAR CLOUDS. Stecher, T. P. (Goddard Space Flight Center, Greenbelt, MD); Williams, D. A. Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 51P-54P(Sep 1974).

Mechanisms for forming and destroying interstellar CH and CH$^+$ are discussed. The most rapid production of CH$^+$ usually occurs in reaction of C$^+$ with vibrationally excited H$_2$. However, if dissociative recombination of CH$^+$ with electrons is fast (rate coefficient $\sim 10^{-7}$ cm^3 s^{-1}), then known processes in an equilibrium situation cannot account for the observed column density of CH$^+$. A non-equilibrium model is then necessary. (auth)

4307 FAR–INFRARED EMISSION FROM H II REGIONS. II. MULTICOLOR PHOTOMETRY OF SELECTED SOURCES AND 2′.2 RESOLUTION MAPS OF M42 AND NGC 2024. Harper, D.A. (Yerkes Observatory). Astrophys. J. 192: No. 2, 557-571 (1 Sept 1974).

Medium– and broad–bandwidth photometric measurements have been made of seven compact H II regions at wavelengths between 30 and 650 μ. The results are consistent with the hypothesis that the far–infrared flux is continuum radiation from dust grains. Color temperatures range from 33° K to 85° K. For most of the sources, the infrared flux is low enough that the dust could conceivably be mixed with the ionized gas. In at least one case [G133.9+1.1/W3(OH)], however, the far–infrared spectrum and luminosity of the source cannot be reconciled with reasonable grain models unless the far–infrared flux comes from a shell surrounding the H II region. M 42 (Orion) and NGC 2024 (Orion B) have been mapped at 90 μ with a resolution (half–power beam diameter) of 2′.2. Although the peak far–infrared brightness in M42 occurs at the position of the Kleinmann–Low infrared nebula, most of the flux originates in a more extended (~6′×8′) source. The energy for the diffuse component could be supplied by the stars in the Trapezium cluster. However, the single early–type star visible in NGC 2024 is not luminous enough to account for either the infrared flux or the observed free–free flux. The data are compared with results of measurements at shorter infrared wavelengths and with studies of the free–free continuum and atomic and molecular line emission at radio frequencies. The observations seem consistent with the idea that the far–infrared flux is formed in the interface between the H II regions and nearby H I regions. However, the current evidence is inconclusive, and alternative explanations cannot be ruled out. The previously noted linear dependence of the far–infrared flux from compact thermal radio sources on their centimeter–wavelength flux densities is reconsidered in the context of a discussion of the energetics of dust–filled H II regions. (auth)

4308 INFRARED EMISSION FROM H II REGIONS. Panagia, N. (Center for Radiophysics and Space Research, Cornell University, Ithaca, N. Y. 14850). Astrophys. J. 192: No. 1, 221-232 (15 Aug 1974).

Models of dusty H II regions have been constructed to study how the power absorbed by dust and reemitted in the infrared depends on the amount, distribution, and properties of dust grains and the spectral type of the exciting star. A large variety of possible situations have been examined. Lα radiation has been found not to be the dominant source of dust heating unless the optical depth of dust in the ultraviolet is small (and the absorbed power also is small). Nonionizing stellar radiation turned out to be at least as important as the Lyman continuum radiation for the heating of dust. The ratio of the expected infrared luminosity to the Lα luminosity has been shown to be a sensitive function of both the dust optical depth and the spectral type of the exciting star. A quantity has been defined which is strongly dependent only on the optical depth of the dust presented inside an H II region and which can easily be derived from available radio and infrared data. Very recent and extensive infrared data (Emerson, Jennings, and Moorwood) have been analyzed with the following results: (1) Dust is mixed with gas in compact H II regions; it absorbs on the average two–thirds of the Lyman continuum radiation; (2) The grains have high infrared absorption efficiency ($Q \simeq 10^{-2}$ at $\lambda \simeq 50$ μ); (3) The average size of grains is larger than 0.05 μ and smaller than 0.15 μ; (4) The average dust–to–gas mass ratio is 10^{-2}; (5) It is possible that dust in H II regions is overabundant relative to the interstellar medium. (auth)

4309 SCINTILLATION AND APPARENT ANGULAR DIAMETER. Cohen, M.H. (Owens Valley Radio Observatory, California Institute of Technology); Cronyn, W.M. Astrophys. J. 192: No. 1, 193-197 (15 Aug 1974).

Angular scattering, intensity scintillations, and apparent diameter are discussed in the context of arbitrary irregularity structure. The intrinsic diameter of a source can always be measured with an interferometer in the presence of arbitrarily strong scattering unless all three of the following conditions apply: (1) intrinsic diameter is less than scattering angle, (2) the source displays weak or no intensity scintillations, (3) a point source shows strong intensity scintillations. If these conditions do apply, the apparent diameter is the scattering angle. (auth)

4310 THE VELOCITY FIELD OF NGC 4258. van der Kruit, P.C. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology). Astrophys. J. 192: No. 1, 1-19 (15 Aug 1974).

Determination of the velocity field of NGC 4258 is reported, derived from slit spectra obtained with the Hale 200–inch (5–m) and 60–inch (1.5–m) telescopes at Palomar Mountain. The central region, the normal spiral arms, and the anomalous Hα arms have been covered, and a final velocity contour map is given in a figure, where the accuracy is somewhat better than one contour unit (50 km s^{-1}). It is shown that the motions in the normal arms are consistent with pure rotation when new values are adopted for the position angle of the line of nodes (146°) and the inclination (72°). These are consistent with the outline of faint outer arms and the distribution of neutral hydrogen derived in Westerbork. An approximate "basic" rotation curve is adopted, and an analysis of the velocity field then indicates that if no motion perpendicular to the plane is important, the Hα arms rotate considerably more slowly, and in the regions around the minor axis contractions occur. These observations are consistent with the predictions of a model proposed earlier by van der Kruit, Oort, and Mathewson in connection with radio–continuum observations. (auth)

4311 THE TRANSPARENCY OF THE SMALL MAGELLANIC CLOUD. Hodge, P.W. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory, Cambridge, Massachusetts 02138). Astrophys. J. 192: No. 1, 21-27 (15 Aug 1974).

Galaxy counts covering an 85–square–degree area around the Small Magellanic Cloud indicate that the total mass of dust (outside of discrete clouds) is approximately 5×10^5 $M_\odot$, that the dust is distributed similarly to H I, that the ratio of neutral hydrogen mass to dust mass is approximately 300, and that the early Harvard study was erroneous because of misidentifications. (auth)

4312 THE FRACTIONAL IONIZATION IN DENSE INTERSTELLAR CLOUDS. Oppenheimer, M.; Dalgarno, A. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. 192: No. 1, 29-32 (15 Aug 1974).

It is pointed out that charge–transfer reactions of complex molecular ions with neutral metal atoms significantly increase the fractional ionization in a dense interstellar cloud bombarded by high–energy cosmic rays. The mean time for ambipolar diffusion becomes comparable to the cloud lifetime only when densities exceed 10^6 cm^{-3} and the magnetic field will retard the gravitational collapse of clouds of smaller particle density. A brief discussion is given of some other consequences of the relatively high fractional ionization. (auth)

4313 SOME PROPERTIES OF H_2CN^+: A POTENTIALLY IMPORTANT INTERSTELLAR SPECIES. Pearson, P.K.; Schaefer, H.F. III (Department of Chemistry, University of California, Berkeley). Astrophys. J. 192: No. 1, 33-36 (15 Aug 1974).

Ab initio quantum–mechanical electronic–structure calculations have been performed on the molecular ion H_2CN^+. Geometries have been predicted for both the acetylene–like ($C_{\infty v}$) and formaldehyde–like (C_{2v}) isomers. The linear structure $H-C-N-H^+$ is predicted to lie lower by 3.0 eV. Thus, the properties of the H_2CN^+ ion are expected to be rather similar to those of acetylene. For the vibrational frequencies, this similarity is demonstrated theoretically. The implications of these results for interstellar chemistry are discussed, including the intriguing possibility that H_2CN^+ may be the precursor of the tentatively identified (90.665 GHz) HNC molecule. The surprisingly high observed DCN/HCN ratio is also discussed. The $J = 0 \rightarrow J = 1$ rotational transition is predicted to occur at 74.8 GHz, with an expected reliability of 1.1 GHz. (auth)

4314 STATIC EQUILIBRIA OF THE INTERSTELLAR GAS IN THE PRESENCE OF MAGNETIC AND GRAVITATIONAL FIELDS: LARGE–SCALE CONDENSATIONS. Mouschovias, T.C. (Physics Department, University of California, Berkeley). Astrophys. J. 192: No. 1, 37-49 (15 Aug 1974).

We present equilibrium states of the interstellar gas, which has run down the perturbed magnetic field lines of a stratified, isothermal initial state under the action of a vertical galactic gravitational field. The final states are lower in total energy than the corresponding initial states. Their properties depend quantitatively on the horizontal (but not so much on the vertical) wavelength of the initial perturbation. A striking feature of the final states is that the scale height of the gas increases (decreases) where the gas density increases (decreases). A connection between initial and final states is made by conserving the mass–to–flux ratio to each flux tube. Thus, although we determine final equilibrium states by solving a time–independent problem, in a time–dependent problem, our final states can be reached from the corresponding initial states through continuous deformations of the field lines. The final states are consistent with observations in the solar neighborhood. We treat the interesting case of the magnetic pressure being initially comparable to the pressure of the thermal gas. We show that the isothermal gas–field–gravity system possesses an "energy integral." An effective potential energy is identified, and an "energy principle" follows as a corollary. The iterative procedure used in order to solve the magnetohydrostatic equations is outlined, and upper limits on the numerical errors are given. We also extend our formalism so that it can apply to the case of a general (rather than an isothermal) equation of state. (auth)

4315 ON THE VELOCITY DEPENDENCE OF THE INTERSTELLAR Na I/Ca II RATIO. Siluk, R.S.; Silk, J. (Department of Astronomy, University of California, Berkeley). Astrophys. J. 192: No. 1, 51-57 (15 Aug 1974).

The correlation noted by Routly and Spitzer between the ratio of the column densities of interstellar Na I and Ca II and radial velocity in the spectra of 21 early–type stars is reinvestigated on the basis of more recent data for 64 stars. The original result is confirmed, and it is further demonstrated that the low values of Na I/Ca II are associated with large peculiar velocities relative to the local standard of rest. It is proposed that the bulk of the high–velocity components can be interpreted as old supernova remnants. A statistical analysis of the distribution with velocity of interstellar Ca II K lines observed by Adams in the directions of some 300 early–type stars is found to be consistent with this hypothesis. (auth)

4316 OSCILLATOR STRENGTHS FOR NEUTRAL SODIUM AND THE INTERSTELLAR SODIUM ABUNDANCE IN ZETA OPHIUCHI. Erman, P.; Brzozowski, J. (Research Institute for Physics, Stockholm, Sweden); Hayden Smith, W. Astrophys. J. 192: No. 1, 59-62 (15 Aug 1974).

Using the high–frequency deflection technique, we have measured radiative lifetimes for the 4p and 5p upper states in Na I, along with relative populations of a number of ns and nd states. These data have been used to obtain f–values for the corresponding resonance transitions in Na I, which proved to be in reasonable agreement with previous oscillator strengths. From the theoretical curve of growth for pure Doppler broadening, we give revised line ratios for D_1/3303, and compare with observations of Na I in ζ Oph. (auth)

4317 MAPS OF SPATIAL AND KINEMATIC STRUCTURE OF GALACTIC NEBULAE. I. H 76α STUDIES OF M17, M42, W51, AND DR 21. Gull, T.R. (Kitt Peak National Observatory); Balick, B. Astrophys. J. 192: No. 1, 63-70 (15 Aug 1974).

We have mapped M17 and M42 and observed W51 and DR 21 in the 76α transitions (2 cm) using the NRAO 140–foot (43–m) telescope. The spatial and velocity structure of M42 in this transition is very similar to structure observed in higher–α transitions. We find that a two–component velocity structure is present in M17. The two radial components are typically separated by ~17 km s^{-1} and are observable throughout a large portion of the radio nebula. W51 and DR 21 have H and He 76α lines similar to other recombination lines. C II was detected in all regions except DR 21. (auth)

4318 A SEARCH FOR PRIMEVAL GALAXIES AT HIGH REDSHIFTS. Partridge, R.B. (Haverford College, Haverford, Pennsylvania). Astrophys. J. 192: No. 2, 241-249 (1 Sept 1974).

Using both photoelectric and photographic techniques, we have searched for primeval galaxies, those undergoing a bright initial phase, at high redshifts. Measurements were made in the optical and near–infrared. The negative results set constraints on models of galaxy formation and evolution. A companion paper by Davis and Wilkinson extends these results. (auth)

4319 EFFECT OF INELASTIC ELECTRON–ATOM COLLISIONS ON THE BALMER DECREMENT. Adams, W.M.; Petrosian, V. (Institute for Plasma Research, Stanford University). Astrophys. J. 192: No. 1, 199-205 (15 Aug 1974).

We have calculated the Balmer decrement in radiatively ionized hydrogen gas as a function of temperature and density, taking into account the effect of electron–atom collisions. It is found that once the electron density exceeds 10^{10} cm^{-3} significant deviations from the normal radiative recombination decrement begin to occur. Implications of these results for the physical conditions in the line emitting region of the Seyfert galaxy NGC 4151 are discussed briefly. (auth)

4320 SEARCH FOR PRIMEVAL GALAXIES. Davis, M.; Wilkinson, D.T. (Joseph Henry Laboratories, Physics Department, Princeton University). Astrophys. J. 192: No. 2, 251-259 (1 Sept 1974).

Most models for galaxy formation in an evolving Universe include a high–luminosity epoch of bright star formation at a redshift of $2 < z < 100$. These objects could have escaped detection on deep red photographic plates if they are extended (~100 $arcsec^2$) and fade into the sky background. This paper reports an unsuccessful search for extended red objects, in apparently blank regions of the sky. A special photometer with high red sensitivity was used to compare the sky brightness in two halves of a circular aperture. Search beams between 17″ and 40″ diameter were used, and altogether 2.0×10^4 $arcseconds^2$ were searched. With 90 percent confidence, there was no object in the area searched with a flux greater than 38×10^{-29} ergs cm^{-2} s^{-1} Hz^{-1} in our bandpass of 6200–8900 A. Furthermore, fluctuations on a scale of 26″ were smaller than 6×10^{-29} ergs cm^{-2} s^{-1} Hz^{-1}. The results constrain the luminosity and number density of primeval galaxies in the standard model. (auth)

4321 GALACTIC EVOLUTION AND THE FORMATION OF THE LIGHT ELEMENTS. Audouze, J. (California Institute of Technology, Pasadena, California, USA); Tinsley, B.M. Astrophys. J. 192: No. 2, 487-500 (1 Sept 1974).

Evolution of the abundances of the light elements $(A \leq 11)$ is considered in the framework of current theories concerning their origin and alternative models for galactic evolution in the solar neighborhood. Results most consistent with observed abundances are obtained using galactic models in which most of the interstellar gas is processed through stars at early times, and in which there is an inflow of extragalactic gas at a rate comparable to the present stellar birthrate. These features are valuable in accounting, in particular, for the relative abundances of ^{9}Be and ^{6}Li, the possible dependence of Be abundance on stellar age, and the solar—system D abundance. In the framework of evolutionary models, D and ^{3}He may be produced either in the big bang or, less probably, during galactic evolution. The relative solar—system abundances of ^{6}Li, ^{9}Be, ^{10}B, and ^{11}B are readily accounted for by spallation of the interstellar gas by galactic cosmic rays, while most of the ^{7}Li might be produced by suprathermal particles ($\sim$10 MeV per nucleon) either in supernova envelopes or in their vicinity. The effects of various uncertainties on these conclusions are studied, including the rate of destruction of the light elements in stellar envelopes, and the cosmic abundance of boron. (auth)

4322 THE STRUCTURE OF AN H I—H II BOUNDARY. Macpherson, A.K. (Department of Mechanical Engineering and Mechanics, Lehigh University). Astrophys. J. 192: No. 2, 369-378 (1 Sept 1974).

In the present study, a radiation—driven shock wave, which is generated in interstellar space by a contracting star, is studied using the BGK model of the Boltzmann equation to obtain insight into the H I—H II boundary wave structure. An examination of the resultant wave systems involving atoms, electrons, protons, and photons provides possible explanations of the unexpectedly thick H I shells observed. (auth)

4323 OPTICAL INTERSTELLAR LINES IN DARK CLOUDS. II. K—I AND ULTRAVIOLET SODIUM LINES. Cohen, J.G. (Kitt Peak National Observatory). Astrophys. J. 192: No. 2, 379-382 (1 Sept 1974).

New observations of the K I and ultraviolet Na I interstellar lines are presented for some stars embedded in dense clouds and for a few supergiants. The new observations of weak lines, which are essentially unaffected by the adopted velocity distribution for the interstellar material, support the conclusions previously obtained from the interstellar D—lines of Na I and H— and K—lines of Ca II. The new data, when combined with a discussion of the ionization equilibrium, indicate no or moderate depletions at the edges of clouds, but some depletions in the central regions. (auth)

4324 PHOTOMETRIC PROPERTIES OF MODEL SPHERICAL GALAXIES. Larson, R.B. (Yale University Observatory); Tinsley, B.M. Astrophys. J. 192: No. 2, 293-310 (1 Sept 1974).

This paper presents the results of detailed calculations of the photometric properties of the dynamical models for the formation and evolution of spherical galaxies recently computed by Larson. The models that were found in Paper I to have radial density distributions closely matching those of elliptical galaxies are found to resemble elliptical galaxies also in their colors, mass—to—luminosity ratios, and narrow—band spectral energy distributions. However, the residual star formation activity in the nuclei of these models makes the nuclear colors bluer than normal, suggesting that most elliptical galaxies have lost their residual gas and do not experience current star formation. The effect of the metal abundance gradient of Paper I on the colors has been estimated, and (in the absence of current star formation) it causes the nucleus of a galaxy to appear redder than the outer regions, as is generally observed. The models with expanding boundaries, in which star formation continues to be important at the present time, have colors and mass—to—luminosity ratios which resemble those of spiral galaxies, showing that differences in the photometric properties of different types of galaxies can be understood in terms of different dynamical histories. The evolution of the photometric properties of the models is discussed, and it is concluded that continuing star formation in elliptical galaxies is not likely to affect significantly the rate at which they evolve in color and luminosity. The predicted supernova rates in models whose UBV colors resemble those of different Hubble types of galaxies agree with the observed supernova rates in these types of galaxies. (auth)

4325 KINEMATIC PHENOMENA IN THE NUCLEAR REGION OF M81. Goad, J.W. (Center for Astrophysics, Harvard College Observatory). Astrophys. J. 192: No. 2, 311-317 (1 Sept 1974).

Radial velocity gradients along the major and minor axes of M81 have been derived from four spectrograms of moderately high dispersion ($\sim$25 Å mm^{-1}). Measurements of Hα and the nearby emission lines of [N II] and [S II] generally extended to about 5″ from the nucleus. The average tilt of the lines along the minor axis is significantly greater than the tilt observed along the major axis. Interpreted in terms of a radial outflow of ionized gas in the plane of the galaxy, the data indicate that gas is leaving the inner 50 pc at a rate of about 10^{-2} M$_{\odot}$ year^{-1}. Direct photographs of M81 show no systematic shift in the orientation of the isophotes near the nucleus. The central luminosity distribution suggests that the M/L ratio in the nucleus lies between 2.5 and 15 M$_{\odot}$/L$_{\odot}$. (auth)

4326 COMPARISON OF THE OPTICAL SPECTRUM OF THE FILAMENTS WITH THE SPECTRUM OF THE CENTRAL REGION OF M82. Visvanathan, N. (Harvard College Observatory). Astrophys. J. 192: No. 2, 319-324 (1 Sept 1974).

Linear polarization observations of the line [N II] λ 6583 in the filamentary patch of RD M82 was measured with the Hale reflector at Palomar to be 27 percent at 54°. These values are nearly the same as those of the continuum and Hα line from the same patch, which rules out fluorescence as a plausible mechanism for the origin of Hα in the filaments. The emission—line spectrum and the continuum of the same filamentary patch RD have also been observed with the multichannel scanner. The observed Balmer decrement is steep, and it is interpreted as due to Whitford—like reddening by dust, corresponding to a value of 2.2 mag at V. The dereddened fluxes of the forbidden lines [O II]λ3727, [O II]λ5007, [N II]λ6584, and [S II]λ6724 with respect to H β as well as the shape of the dereddened continuum from 3300 to 9000 Å in the patch RD are found to agree with those of the luminous H II region M82 A located in the central region of the galaxy. Further, the dereddened emission—line and continuum spectrum in the range 3300—9000 Å of patch RD is nearly the same as that of M82 A dimmed by a factor of about 234. Considering that the polarization data suggest scattering of both the permitted and forbidden—line emission and the continuum from a source in the central region of the galaxy, we are convinced that our results support the H II region M82 A located in the central region of the galaxy as the source of the scattered light in the filaments. However, the observed velocity field is still not understood on this simple scattering model with purely radial motions. (auth)

4327 RADIO FINE STRUCTURE IN THE GALACTIC CENTER. Balick, B.; Sanders, R.H. (National Radio Astronomy Observatory, Charlottesville, Virginia). Astrophys. J. 192: No. 2, 325-335 (1 Sept 1974).

Synthesis maps of the Sgr A and Sgr B2 regions at 2695 and 8085 MHz have been obtained using the three—element interferometer of the National Radio Astronomy Observatory (NRAO). The highest resolution achieved is 2″. In both Sgr A and Sgr B2 continuum fine structure has been observed (size $\lesssim 10''$) and in both cases the observations at the two frequencies indicate that this small—scale structure is probably thermal emission from hot optically thick regions. Much of the Sgr A fine structure is directionally coincident with infrared sources thought to be at the galactic center, and therefore probably arises from hot dense gas very near the center. Conditions near the galactic center relevant to these observations are discussed. The Sgr B2 fine structure is probably higher density but otherwise similar to compact H II regions associated with other complexes of galactic H II regions and molecular clouds. (auth)

4328 THE NUCLEI OF PECULIAR EMISSION—LINE GALAXIES. Osmer, P.S.; Smith, M.G. (Cerro Tololo Inter—American Observatory, La Serena, Chile); Weedman, D.W. Astrophys. J. 192: No. 2, 279-291 (1 Sept 1974).

The nature of the nuclear activity in six Sérsic—Pastoriza spirals with morphologically peculiar nuclei (NGC 613, 1097, 1365, 1672, 1808, and 2997), in the peculiar galaxy NGC 5253, and in the interacting galaxy NGC 2992, is studied using spectrophotometry of emission lines and continua. In the Sérsic—Pastoriza nuclei the emission spectra are similar to those of normal H II regions except that the Balmer decrements are very steep, indicative of large reddening. Hot stars are the most plausible source of ionizing radiation; their contribution to the optical continuum is masked by the interstellar absorption. After correction for interstellar absorption, the Hβ luminosities are one to two orders of magnitude larger than those of typical giant H II regions. Such large numbers of ionizing stars are required that the present levels of activity must result from transitory bursts of star formation. The emission—line region in NGC 5253 has higher excitation and a much bluer continuum than the Sérsic—Pastoriza nuclei, and the reddening is relatively small. The total Hβ emission is comparable to that of a typical giant H II region and consequently the present rate of star formation could have been supported for a much longer time than in the Sérsic—Pastoriza nuclei. NGC 2992 has both very high excitation and a steep Balmer decrement which, if caused by reddening, leads to a luminosity in Hβ comparable to that of the brighter Seyfert galaxies. Its activity may be related to the interaction with the nearby NGC 2993. (auth)

4329 MULTIPLET SPLITTINGS AND $^{1}S_{0}-{^{3}P_{1}}$ INTERCOMBINATION—LINE OSCILLATOR STRENGTHS IN Be I

AND Mg I. Laughlin, C.; Victor, G.A. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory, Cambridge, Massachusetts). Astrophys. J. 192: No. 2, 551-556 (1 Sept 1974).

Model potential methods are used to calculate electric dipole oscillator strengths and transition probabilities for 2sns $^1S_0$−2smp $^3P_1$ transitions in Be I and 3sns $^1S_0$−3smp $^3P_1$ transitions in Mg I. Comparison of predicted multiplet splittings and oscillator strengths with available experimental and theoretical data demonstrates that the procedures employed are capable of producing results of high accuracy. The calculated Mg I $3s^2$ $^1S_0$−3s3p $^3P_1$ transition oscillator strength is 2.11×10^{-6}. (auth)

4330 THE INTENSITY DISTRIBUTION OF DIFFUSE GALACTIC Hα EMISSION. Reynolds, R.J.; Roesler, F.L.; Scherb, F. (Physics Department, University of Wisconsin, Madison). Astrophys. J. Lett. 192: No. 2, L53-L56 (1 Sept 1974).

A contour map of spatially diffuse, galactic Hα emission has been constructed from Fabry−Perot observations in over 300 directions between galactic longitudes 0° and 240° and galactic latitudes −50° to +30°. The map, with a limiting emission measure of less than 4 cm^{-6} pc, presents a new, large−scale view of the distributed, ionized component of the interstellar medium within about 2 kpc of the Sun. (auth)

4331 ON THE SPECTRUM OF NEUTRAL OXYGEN IN THE ORION NEBULA. Münch, G.; Taylor, K. (Hale Observatories, California Institute of Technology, Carnegie Institution of Washington). Astrophys. J. Lett. 192: No. 2, L93-L95 (1 Sept 1974).

Images of the Orion Nebula in radiation of the O I λ8446 permitted lines are shown to have a unique filamentary structure not apparent in the [O I] λ6300 or other nebular lines. High−resolution profiles these same lines are also presented. The O I λ8446 structure is explained in terms of the Lβ resonance with the oxygen 2 ^3P−2^3D transition. The absence of such filamentary structure in Hα, produced also by Lβ decay, is hypothesized to be the result of a concentration of solid particles in the transition H II−H I region of high density where fluctuations of the O I λ8446 emission originate. (auth)

4332 SILICON MONOXIDE: DETECTION OF MASER EMISSION FROM THE SECOND VIBRATIONALLY EXCITED STATE. Buhl, D. (National Radio Astronomy Observatory, Green Bank, West Virginia); Snyder, L.E.; Lovas, F.J.; Johnson, D.R. Astrophys. J. Lett. 192: No. 2, L97-L100 (1 Sept 1974).

The $J=1-0$ rotational transition of the second vibrational state ($v=2$) of SiO has been detected in late M−type variable stars and in the center of the Orion Nebula. This transition of SiO requires 3520°K of excitation for pumping the observed maser line. The ground ($v=0$) and third ($v=3$) vibrational states were not detected. (auth)

4333 INTERSTELLAR MOLECULES: ORIGIN BY CATALYTIC REACTIONS ON GRAIN SURFACES? Anders, E., Hayatsu, R. (Enrico Fermi Institute and Department of Chemistry, University of Chicago); Studier, M.H. Astrophys. J. Lett. 192: No. 2, L101-L105 (1 Sept 1974).

To determine the compound distribution formed by surface catalysis, mixtures of CO, D_2, and ND_3 were heated with nickel−iron or montmorillonite clay catalysts for 49−214 h at 250°−300°C. Compounds identified include most of the known polyatomic interstellar molecules, as well as homologous series of acetylenes, dienes, alcohols, aldehydes, ketones, ethers, esters, nitriles, amines, etc., and cyclic compounds such as furans and pyrroles. These homologous series are uniquely characteristic of surface catalysis. A search for the heavier members of these series, predicted to occur at 10^{-1} to 10^{-3} the abundance of the lightest members, thus comprises a crucial test of this mechanism. (auth)

4334 POSSIBILITY OF IDENTIFYING THE NORMAL INTERPLANETARY MAGNETIC FIELD COMPONENT FROM THE PLANETARY K_p INDEX. Mikerina, N. V.; Ivanov, K. G. (Inst. of Terrestrial Magnetism, Ionosphere and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 123-124(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 149-150.

The possibility of identifying the interplanetary field component F_z from various values of the planetary K_p index was investigated. A statistical analysis of the relation between K_p and F_z from Explorer-33 and Explorer-35 data for the period from December 23, 1967, to June 28, 1968, covering more than 1300 three-hour intervals, was performed. (MHR)

4335 BLACK HOLE: A COMPONENT OF A MASSIVE EMISSION STAR. Guseinov, O. Kh. Tsirk. Shemakh. Astrofiz. Observ.; No. 7, 7-11(Jul 1973). (In Russian).

Five stars containing relativistic components are examined for physical characteristics of mass size, radiant velocity, loss of matter, etc. The search for black holes is being conducted only among multiple systems. Among binaries one of the components should have had a previous mass >2.5 $M_\odot$. In order to eliminate neutron stars, systems with masses >$M_\odot$ are considered. According to stellar evolution, binary systems having these masses live <10^9 years, and hence there should be less than ~10^6 stars in the galaxy. If these systems are so widespread that each star evolves independently, the visible noncollapsed component should be a star earlier than A3, a giant of spectral class M or even a red supergiant. The difficulties associated with searching for black holes among x-ray sources are pointed out. (SJR)

4336 THREE DOUBLE EMISSION NEBULAE. Allen, D. A. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 27P-29P(Aug 1974).

Low dispersion spectra have been taken of three nebulae which are misclassified as Be stars. Two of these appear to be peculiar galaxies, the third appears to be a planetary nebula. (auth)

4337 CORRELATION BETWEEN M/L AND COLOUR FOR SPIRAL GALAXIES. Sargent, W. L. W. (Hale Observatories, Pasadena, CA); Tinsley, B. M. Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 19P-22P(Aug 1974).

The correlation between the mass-to-luminosity ratio M/L and B−V found for spiral galaxies by Nordsieck (Astrophys. J.; 184: 735 (1973)) is compared with theoretical relations for model galaxies with the same initial mass function (IMF). There is evidence that the observed relation is steeper, suggesting that the lower IMF may be enhanced in earlier types of galaxies, but more data are needed to confirm this possibility. (auth)

4338 INTERSTELLAR CH AND CH^+ FROM THE EVAPORATION OF GRAIN MANTLES. Stecher, T. P. (National Aeronautics and Space Administration, Greenbelt, MD); Williams, D. A. Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 23P-26P(Aug 1974).

The model originally suggested by Bates and Spitzer (Astrophys. J.; 113: 441 (1951)) for interstellar molecule production by the evaporation of grain mantles is re-examined. It is shown that allowance for reactions involving CH^+, formerly ignored, removes difficulties which those authors experienced. The essential features of CH and CH^+ observations in the directions of certain stars can be understood on the basis of this model. (auth)

4339 RATIO OF TOTAL TO SELECTIVE ABSORPTION IN THE RHO OPHIUCHI CLOUD. Whittet, D. C. B. (Univ. of Saint Andrews, Eng.). Mon. Notic. Roy Astron. Soc.; 168: No. 2, 371-378(Aug 1974).

The ratio of total to selective absorption, $R = A_V/E_{B-V}$, is determined for the ρ Oph dust cloud by the variable extinction method, using published data for stars in the Sco OB-2 association. The calibration of absolute magnitude in terms of spectral type is discussed and compared with results from Hα and Hβ photometry. A least squares fit to the $E_{B-V}/(V-M_V)$ plot gives an overall result of $R = 3.7 \pm 0.3$. The stars associated with nebulosity give $R = 4.2 \pm 0.5$, while a "normal" value of $R = 3.3 \pm 0.3$ is found for the remainder. The mean distance modulus of the association is deduced to be 6.1 ± 0.1, which agrees well with the kinematical value. (auth)

4340 EQUILIBRIUM OF AN INTERSTELLAR MAGNETIC DISK. Parker, D. A. (Univ. of Hull, Eng.). Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 331-344(Aug 1974).

Equilibrium models of a cool, dense interstellar gas cloud permeated by the locally distorted galactic magnetic field are constructed using a model in which the cloud is assumed to be an infinitely thin disk of finite radius. This approximation is valid provided that the cloud is sufficiently cool. The cloud is assumed to be axisymmetric, isothermal and of mass 10^3 $M_\odot$. The solutions show some enhancement of the magnetic field in the cloud compared to the background strength of 2×10^{-6} Gauss. The effects of uniform rotation about the axis of symmetry are examined. Considerably stronger magnetic fields are found in the rotating disks and in some models the field lines have snapped off forming neutral rings. (auth)

4341 THEORETICAL COMPUTATIONS AND INTERPRETATION OF THE OBSERVED SPECTRA OF THE GASEOUS FILAMENTS OF CRAB NEBULA. Golovatyi, V. V.; Pronik, V. I. Izv. Krym. Astrofiz. Observ.; 48: 47-57(1973). (In Russian).

The ionization of H, He, O, N, Ne, and S in the gaseous filaments of Crab nebulae is computed, and the intensities of main emission lines are calculated. The calculations are made for two cases: the optically thin ($\tau_{L_c} \ll 1$) filaments and optically thick ($\tau_{L_c} \gg 1$) filaments in Layman continuum. The observed mean spectrum of filaments was shown to be in good agreement with the theoretical one for the model $\tau_{L_c} \gg 1$, $F_{912Å} = 1.5 \cdot 10^{-26}$ watt/m^2c/s, $\alpha = -0.55$, $n_e = 10^3$ cm^{-3} and for the abundances of chemical elements found by Woltjer. The observed difference in intensities of various filaments may be explained by variations of the electron temperature and ionization in filaments. (auth)

4342 SPECTRAL INVESTIGATION OF THE GALAXY BULGE OF NGC 4303. Nazarova, L. S.; Shcherbakov, A. G. Izv. Krym. Astrofiz. Observ.; 48: 37-46(1973). (In Russian).

The distributions of intensity in the continuous spectrum of different parts of spiral galaxy NGC 4303 are obtained from photoelectric and photographic photometry in the range 3340 to 7400 Å. Also the spectrum of nucleus of this galaxy is measured in the region 4000 to 7000 Å with the dispersion 330 Å/mm. The observations were made with 2.6 meter telescope of the Crimean Astrophysical Observatory. It is shown that the energy distribution in the spectrum of bulge differs slightly from that of outer regions. The continuous spectrum of the galaxy bulge has a jump in 3600 to 4000 Å region. The ratio of flux at λ = 4000 Å to the flux at λ = 3600 Å is 4.4 ± 0.65. The attempt is made to interpret the Balmer jump in the spectrum of bulge as due to A–F stars and dust. The lines in the spectrum of the nucleus are in emission but all visible emission hydrogen lines are accompanied by absorption components. The flux of L_c radiation which to ionize the hydrogen in the nucleus of galaxy is estimated to be 1.6×10^{-29} watt/m^2 c/sec. Continuous spectrum of nucleus of NGC 4303 in the frequency range 10^8 to 10^{16} c/sec is compared with the spectrum of nucleus of Seyfert galaxy NGC 1068. The comparison shows similarity of continuous spectrum of both galaxies. (auth)

4343 FORMATION OF HEAVY ELEMENTS IN SUPER NOVAE. Sato, K. (Kyoto Univ.). Uchusen Kenkyu; 17: No. 4, 550-557(Feb 1973). (In Japanese).

From symposium on charged particles and cosmic radiation; Hamamatsu, Japan (Dec 1971).

The mechanism of production of heavy elements in the explosion of supernovae is discussed. The life of star is determined by the mass and chemical composition at the time when the star was formed. Taking general chemical composition, the final state of star is determined by mass, and is black hole, pulsar, carbon detonation, or white dwarf (or planetary nebula). The carbon detonation was discussed, and it is the feature that the carbon detonation does not leave white dwarf or pulsar. However it is too early to make any conclusion concerning this relation. The most important process for the formation of pulsar is the neutrino process. Energy around 10^{53} erg can be carried away by neutrinos. The γ-process which is important for the formation of heavy nuclei needs a neutron density of more than 10^{24}/cm^3 and the temperature above 10^9 °K. This condition can be realized only in the materials which are blown out by the carbon detonation. Other processes to be considered are mass loss, supernovae of the carbon detonation other than the process explained above, and iron break-up type supernovae. (Kato, T.)

4344 SPECTRA OF GASEOUS NEBULAE. Seaton, M. J. (University Coll., London). pp 121-153 of Atoms and Molecules in Astrophysics. Carson, T. R. (ed.). New York; Academic Press, Inc. (1972).

From 12th session of Scottish universities summer school in physics atoms and molecules in astrophysics; Stirling, UK (Aug 1971). See CONF-710859-.

Lectures are presented in which the physical and chemical properties of gaseous nebulae are investigated and the physical processes involved are explained. Special attention is given to recent work on spectral lines observed at radio wavelengths. Some basic physics formulas are collected. (JFP)

4345 STUDY OF POSSIBLE MODELS FOR BALMER EMISSION LINE REGIONS IN SEYFERT GALAXIES. Adams, W. M. Palo Alto, CA; Stanford Univ. (1974). 98p. University Microfilms Order No. 74-13,594.

Thesis (Ph. D.).

This study is directed toward two unexplained phenomena exhibited by the Balmer emission lines in Seyfert galaxies: their unique profile structure, and their anomalous intensity ratios. The study of the line profiles consists of an examination of three proposed mechanisms for explaining the broad wings found on the Balmer lines in several of these objects. The models considered are a uniform medium in which self-absorption of allowed lines increases their escape path length, thus increasing the probability of their being electron scattered so as to account for the wings; the line wings are formed in a separate region with high velocity dispersion; and the lines with wings are formed in a separate region where the electron optical depth is greater, thus creating the wings by electron scattering. It is concluded that the evidence favors the third possibility. The study of the Balmer line intensity ratios commences with a careful analysis of the observed data and the amount of significance that can reasonably be attached to it. Next there is a brief review of the results of basic radiative recombination theory. This is followed by an investigation of the appropriateness of using a Maxwellian electron distribution function in collisional excitation calculations, and it is determined that under some conditions this distribution function may become significantly non-Maxwellian. A calculation is given of the Balmer decrement emitted by a gas of sufficiently high density so that electron-atom collisions significantly affect the hydrogen energy-level populations. Finally, the various theoretical possibilities are compared with the results of an analysis of the observations. It is concluded that dust reddening mixed with some self-absorption will give a satisfactory fit for most of the observed galaxies but not for NGC 4151, the brightest (i.e., most intense) of those observed. For this galaxy the results of calculations give a good fit, but the physical conditions required are difficult to maintain, and no definite conclusions can be drawn. (Diss. Abstr. Int., B)

Cosmology

Refer also to abstracts 3394, 4209, 4318, 4320, 5008, 5077, and 5151.

4346 (AD-776284/2) FURTHER OBSERVATIONS AT THE INTERSTELLAR DEUTERIUM FREQUENCY. Cesarsky, D. A.; Pasachoff, J. M. (Owens Valley Radio Observatory, Pasadena, Calif. (USA)). 1974. Contract N00014-67-A-0094-0019. 12p. NTIS $3.00.

The authors repeated observations of the galactic center in the vicinity of the deuterium ground-state hyperfine transition at 327 MHz. In this year's observations, they tried to use a wider bandwidth to better match the possible line shape while increasing the baseline. Not all the baseline appears interference free, and the overall noise level after 40 hours on source to last year's. The absorption dip that would correspond to a deuterium line at V(LSR) = −3.7 km/sec again appears, with a comparable, statistically insignificant strength. Merging the data from both years gives an upper limit of 3.5×10^{-4} and a range, if the absorption is the deuterium line, from 3.5×10^{-4} to 2×10^{-5}. This implies cosmic densities insufficient to close the Universe. (auth)

4347 USE OF A NONISOCHRONOUS OSCILLATOR IN REGISTERING SMALL FORCE INTERACTIONS IN A GRAVITATIONAL WAVE DETECTOR. Braginskii, V. B.; Kuklachev, M. I.; Mitrofanov, V. P. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 3, 358-360(1974). (In Russian).

A gravitational wave interacts with an extended solid body (a pendulum), and excites mechanical oscillations in the basic quadrupole mode. The resonance frequency of such a detector is determined by the dimensions of the pendulum. The use of an oscillator with an artificially induced nonlinearity is proposed. Then because of the presence of nonisochronicity in the system it is possible to note the interaction of the external force from the phase change of the oscillations, since the frequency of the particular oscillations in the case of a nonisochronous system depends on the energy which it possesses at a given moment of time. The equation of motion of a nonlinear oscillator under the action of an external harmonic force is given. Expressions are derived for the amplitude and phase by a method of asymptotic approximations. A coefficient characterizing the nonlinearity of the system is introduced. Numerical estimates of system parameters are presented. (SJR)

4348 GENERAL RELATIVITY, AND ITS APPLICATIONS TO SELECTED ASTROPHYSICAL AND COSMOLOGICAL TOPICS. Block, D. L. (Univ. of the Witwatersrand, Johannesburg). Quart. J. Roy. Astron. Soc.; 15: No. 3, 264-291(Sep 1974).

The subject is treated under the following heads: the redshift in a model universe; intensity fluctuations of light signals in a medium of statistically distributed gravitational waves—weak field approximation (close binary systems, quasi-stellar objects); gravitational radiation and mass transfer in close U Geminorum-type binaries (the proposed model, applications of relativistic theory); black holes and general relativity (zero pressure model, the effect of pressure on gravitational collapse, the effect of a magnetic field and rotations on collapse); starquakes in neutron stars, and the resulting pulsar speed-up (Baym–Pines model, gravitational radiation in a neutron starquake); gravitational redshifts in quasi-stellar objects. (UK)

4349 DISTANCE AND LARGE REDSHIFTS. McVittie, G. C. (Univ. of Kent, Canterbury, Eng.). Quart. J. Roy. Astron. Soc.; 15: No. 3, 246-263(Sep 1974).

It is stated that the object of the paper is to describe, in as non-technical a way as the subject permits, the cosmological distance problem. To do so requires, first, a definition of what exactly distance means, and secondly, one or more formulae for converting redshifts into distances. Tables for performing this conversion are given and are intended for calculating chiefly the distances of quasars, whose redshifts now run up to 3.53. The redshifts of galaxies and of quasars are treated in this paper as arising from the same physical cause, i.e., a Doppler effect, due to the relative motion of the observer and the luminous source. The discussion is restricted to zero-pressure models of the Universe in relativistic cosmology. Depending on the definitions employed, six different "distances" are identified and discussed. The specification in light years of the distance of an object whose redshift has been measured by the observer involves three items of information: a statement of which kind of distance is meant, the model universe to be used, and the magnitude of the scale-factor $R(t_0)$ in light years. A detailed discussion follows of (i) the model universe (ii) the Hubble constant (iii) distances, including tables for three kinds of distances for seven different models. (UK)

4350 DISCRETE SOURCE MODEL OF THE MICROWAVE BACKGROUND. Rowan-Robinson, M. (Queen Mary Coll., London). Mon. Notic. Roy. Astron. Soc.; 168: No. 3, 45P-50P(Sep 1974).

An interpretation of the microwave background is given in terms of Seyfert and active galaxies in a low-density Universe. At early epochs ($z \sim 100$) all galaxies would have been strong emitters in the sub-millimetre region of the spectrum. As time proceeds, the probability of a galaxy's being an emitter and the strength of the emission from those galaxies alight decline until at the present epoch about 1 per cent of galaxies, the Seyfert galaxies, are alight. The background spectrum would differ from a 2.7 K blackbody only at wavelengths below 3 mm. The model could be ruled out if Pariskij's upper limit on background fluctuations is confirmed or slightly strengthened. (auth)

4351 COHERENT PONDEROMOTOR GRAVITATIONAL FORCES. Braginskii, V. B.; Sokolov, D. D. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 4, 488-490(1974). (In Russian).

An effect by means of which in principle it is possible to detect the gravitational radiation of a source without direct reception of the radiation by reaction of the source to the radiation. Consideration is given to two coherent sources of gravitational waves of power N and frequency ω in the form of an oscillating dumbbell. Assume that the sources are at a distance from each other much less than the wavelength of the radiation. The total power of the radiation at a definite phase relation will be in view of coherentness not 2N, but 4N. It is natural therefore that a radiation pressure force equal to N/c acts on the source. The moment of the force is equal to N/ω. Under present conditions it is possible to detect a rotational momentum of 10^{-11} dyne-cm at masses of 10^1 to 10^2 grams, that is, the effect can be observed on creating a source of gravitational radiation with a power of 10^{-3} erg/sec at a radiofrequency of 10^7 hertz. Quantitative calculations are presented. (SJR)

4352 CONVERSION OF ELECTROMAGNETIC TO GRAVITATIONAL RADIATION BY SCATTERING FROM A CHARGED BLACK HOLE. Olson, D.W.; Unruh, W.G. (Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. Lett. 33: No. 18, 1116-1119 (28 Oct 1974).

When a purely electromagnetic incoming wave is scattered by a charged black hole, the electromagnetic—gravitational coupling can lead to conversion to gravitational radiation in the outgoing wave. Analytic estimates and numerical results are given for this effect, which proves to be significant only for maximally or near—maximally charged black holes. (auth)

4353 RED GIANT, PLANETARY NEBULA, WHITE DWARF: AN EVOLUTIONARY SEQUENCE. Guseinov, O. Kh. Tsirk. Shemakh. Astrofiz. Observ.; No. 6, 8-10(Jun 1973). (In Russian).

It is argued that red giants primarily have masses of $\sim 1.3\ M_\odot$ ($M_\odot$ is astronomical mass units). The mass of a planetary nebula is $\sim 0.3\ M_\odot$. Hence a red giant can lose a mass of $\sim 1.0\ M_\odot$ as the parent star, and become a planetary nebula. The shell of the red giant can be separated from the central part by magnetic pumping so that it becomes possible to have the evolutionary sequence of a red giant turning into a planetary nebula which can turn into a white dwarf. (SJR)

4354 MINIMAL ASSUMPTIONS LEADING TO A ROBERTSON-WALKER MODEL OF THE UNIVERSE. Straumann, N. (Univ., Zurich). Helv. Phys. Acta; 47: No. 3, 379-383(1974).

It is shown that the structure of the Robertson-Walker models of the universe is already implied by the assumption that the space-time manifold is isotropic at every point relative to the vector field in the sense of the definition given. (JFP)

4355 RIDDLE OF THE REDSHIFTS. Burbidge, G. (Univ. of California, San Diego, La Jolla). Mitt. Astron. Ges.; No. 34, 19-42(1973).

From proceedings of the astronomical society; Oberkochen, Germany (24 Apr 1973).

Somewhat more than 40 years ago Hubble and Humason conclusively established that the redshifts of the galaxies are proportional to their apparent brightnesses. With this discovery came the general conclusion that the redshifts were due to the Doppler effect and that the Universe is expanding. The discovery of QSOs with large redshifts led to the conclusion that if the redshifts were measures of distance the objects were at immense distances and in general some 50 times brighter than most luminous galaxies. Arguments for and against the cosmological redshifts hypothesis are evaluated, giving attention to QSO variability, questions of relativistic expansion, the redshift–apparent magnitude diagram, the redshift–angular diameter relation, the distribution of redshifts, multiple redshifts, and distance measurements in extragalactic astronomy. (IAA)

Planetary Phenomena

Refer also to abstracts 4217 and 4309.

4356 (CONF-741002-P1, pp xxi-xxviii) EVOLUTION OF THE MOON: THE 1974 MODEL. Schmitt, H. H. (Lyndon B. Johnson Space Center, Houston, TX). 1974.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

In proceedings of the 11th rare earth research conference.

The probability is very great that the geology of the decade of Apollo and Luna will become one of the fundamental turning points in the history of all sciences. For the first time the scientists of the earth have been presented with the opportunity to interpret their home planet through the direct investigations of another. The interpretive evolution of the moon can be divided now into seven major stages beginning sometime near the end of the formation of the solar system. These stages and their approximate durations in time are as follows: 1. the Beginning—4.6 billion years ago, 2. the Melted Shell—4.6–4.4 billion years ago, 3. the Cratered Highlands—4.4–4.1 billion years ago, 4. the Large Basins—4.1–3.9 billion years ago, 5. the Light-colored Plains—3.9–3.8 billion years ago, 6. the Mare Basalts—3.8–3.0 (?) billion years ago, and 7. the Quiet Crust—3.0(?) billion years ago to the present. The Apollo and Luna explorations that are the basis for study of these stages of evolution each have contributed in progressive and significant ways. They provide new insight into the early differentiation of the earth, the nature of the earth's protocrust, the influence of the formation of large impact basins in that crust, the effects of early partial melting of the protomantle, and possibly the earliest stages of the breakup of the protocrust into continents and ocean basins. (auth)

4357 TRACE ELEMENTS IN PRIMITIVE METEORITES. V. Abundance Patterns of Thirteen Trace Elements and Interelement Relationships in Enstatite Chondrites. Binz, C. M.; Kurimoto, R. K.; Lipschutz, M. E. (Purdue Univ., Lafayette, IN). Geochim. Cosmochim. Acta; 38: No. 10, 1579-1606(Oct 1974).

Neutron activation analysis was used to determine As, Au, Bi, Cd, Co, Cu, Ga, In, Sb, Se, Te, Tl and Zn in 11 samples representing 9 chondrites of grades E4 to 6. These chondrites exhibit systematic intra- and intergrade differences, particularly for highly-variable elements, the differences being E4 ≥ E3 > E6 ≥ E5. The abundance pattern for these 13 and an additional 16 elements in E3 to 6 chondrites differs from those of other primitive meteorites—the carbonaceous and unequilibrated ordinary chondrites. A search for statistically-significant interelement relationships among the 13 elements (for grades E4 to 6) reveal that 40 element-pairs are linearly and/or exponentially correlated. Similar consideration of data for 37 elements in 12 chondrites (grades E3 to 6) reveals that 191 element-pairs exhibit such relationships, 170 involving linear and/or exponential correlations, the remainder involving anticorrelations. The patterns depicting these relationships—i.e., the correlation profiles—and elemental abundance patterns, factor analysis and two-element correlation diagrams are consistent with all enstatite chondrites representing a single evolutionary sequence. The primary process responsible for the chemical trends of these chondrites involved thermal fractionation accompanied by geochemical fractionation of sulfide-plus-metal from silicate, probably during condensation and accretion of solid material from the solar nebula. Chalcophile elements may have been fractionated during condensation or, after accretion, during thermal metamorphism in the parent body. No genetic model proposed thus far accounts for the detailed chemical trends, although the constrained equilibrium theory and two-component condensation theories qualitatively seem most satisfactory. The correlation profiles of enstatite, carbonaceous and unequilibrated ordinary chondrites are distinctly different, pointing to major differences in the formation conditions of these different sorts of primitive meteorites. (auth)

4358 R-MODE FACTOR ANALYSIS ON ENSTATITE CHONDRITE ANALYSES. Shaw, D. M. (McMaster Univ., Hamilton, Ont.). Geochim. Cosmochim. Acta; 38: No. 10, 1607-1613(Oct 1974).

R-mode factor analysis on 11 specimens of 9 enstatite chondrites, analyzed for Ga, Se, Te, Zn, Cd, Bi, Tl, In, Sb, As, Co, showed three factors (rotated) to account for 92 per cent of the elemental variations (variance). Factor 1 dominates the first 8 elements listed, all volatile and mostly chalcophile: factors 2 and 3 express Sb and As variations, respectively, probably dependent on siderophile and less volatile behavior; factors 1 and 2 contribute to Co. Factor-scores for individual meteorites indicate compositional differences (for these elements) between the E4 as against E5 and E6 stones (which are indistinguishable). Factor analysis of a second suite of 10 specimens analyzed for Zn, Cd, Bi, Tl, In, Ag, Rb, Cs showed one factor to account for 93 per cent of the elemental variance. This expresses the association of Ag, Rb, Cs with the volatile-chalcophile factor. (auth)

4359 TOTAL NITROGEN IN METEORITES. Kothari, B. K.; Goel, P. S. (Indian Inst. of Tech., Kanpur). Geochim. Cosmochim. Acta; 38: No. 10, 1493-1507(Oct 1974).

Total N has been measured in a number of meteorites by neutron activation analysis using the reaction $N^{14}(n,p)C^{14}$. From each meteorite a number of chips have been analyzed to investigate the variation of N contents in a sample. Many meteorites are found to contain a heterogeneous distribution of N. Eighteen chondrites, mostly of the classes C3, H4, H5, L4, L5, L6 and LL6, and six achondrites are found to have average N contents of 10 to 45 ppm. These do not show any clear-cut dependence of N on petrological group. However, the inherent heterogeneity or the fact that from most meteorite classes only single falls were studied might be responsible for this lack of correlation. In Cold Bokkeveld (C2) N is high (420 ppm). Unlike C, N content of ureilites is low (26 ppm). Nitrogen is enriched in the non-magnetic as compared to the magnetic fractions in H-group chondrites. Analyses of sieved Bjurböle phases show no enrichment of N in finer matrix material, nor any depletion in chondrules. In two gas-rich meteorites, Kapoeta and Assam, there is no excess N in the dark phases. Nine iron meteorites and three mesosiderites were analyzed. Twenty analyses of Canyon Diablo and seven of Odessa establish a very heterogeneous N distribution in these meteorites. (auth)

4360 JUPITER EMISSION OBSERVED NEAR 1 MHz. Brown, L.W. (Radio Astronomy Branch, Laboratory for Extraterrestrial Physics, Goddard Space Flight Center, Greenbelt, Maryland). Astrophys. J. 192: No. 2, 547-550 (1 Sept 1974).

Emission from Jupiter has been observed by the IMP–6 spacecraft at 19 frequencies between 600 and 9900 kHz covering the period 1971 April to 1972 October. The Jovian bursts were idenitified in the IMP–6 data through the phase of the observed modulated signal detected from the spinning dipole antenna. Initial data reduction has isolated 177 events over a span of 500 days. These events persisted over a period between 1 and 60 minutes. Of these events at least 48 occurred during times in which Jupiter emission was being observed at either 16.7 or 22.2 MHz by ground–based instruments of the Goddard Space Flight Center Jupiter monitoring system. Large bursts were detectable from 9900 kHz down to 600 kHz, while smaller bursts ranged down to 1030 kHz. (auth)

4361 DEKAMETER RADIATION FROM JUPITER. Lindegren, L. (Univ., Lund). Astron. Tidsskr.; 7: No. 2, 75-85(1974).

Dekameter radiation (DAM) covers the range 5 to 40 MHz and is emitted with a certain periodicity from Jupiter, corresponding almost to the axial rotation. The Jupiter moon Io seems to have a definite relation to certain of the emissions, and it is conjectured that the other moons, especially Europa, may have similar though much less pronounced relations. While the magnetic field of Jupiter is fairly well established little is known of its plasmasphere, but a model can be derived. Two mechanisms are most likely for the emission of electromagnetic radiation, plasma waves and cyclotron radiation. The former is found to involve certain assumptions which do not agree with reality. The latter is shown to be dependent on Io's motion in the Jupiter magnetosphere, and while it explains convincingly the Io-related dekameter radiation it does not account at all for that which is not related to Io. It is therefore suggested that another mechanism, independent of a moon, but triggered by e.g. electromagnetic waves or Alfvén waves initiated by Io would be more satisfactory. (NO)

4362 COSMOGONY OF THE ASTEROIDAL BELT. Alfven, H.; Ip, W. H.; Burkenroad, M. D. (Univ. of California, La Jolla, San Diego). Nature (London); 250: No. 5468, 634-636(23 Aug 1974).

The limits of the main asteroid belt are considered, and it is shown that the asteroids, like the Saturn rings, have condensed from a partially corotating plasma. There are also reasons to believe that condensation from a partially corotating plasma was a basic process in the formation of the Solar System. It is also shown that the whole main belt is located below $2/3$ of Jupiter's orbit, which means that the main belt asteroids may have derived from condensation that took place inside Jupiter's orbit. (UK)

4363 EVOLUTION OF PLANETARY ORBITS. Dormand, J. R.; Woolfson, M. M. (Teesside Polytechnic, Middlesbough, Eng.). Proc. Roy. Soc. (London), Ser. A; 340: No. 1622, 349-365(24 Sep 1974).

Planets produced by the capture-theory model would condense into compact partially segregated bodies in a period of 10^3 to 10^4 years. A resisting medium, which would be a byproduct of the capture process, is shown to give rounding of planetary orbits in 10^4 to 10^8 years, the rounding time being dependent on planetary mass. A collision between two planets is postulated, and it is shown that the larger planet could be ejected from the Solar System. The collision could also provide sufficient energy to break up the smaller planet and so to provide the material for the minor planets. (auth)

4364 TUNGUS EVENT WAS NOT CAUSED BY A BLACK HOLE. Beasley, W. H.; Tinsley, B. A. (Univ. of Texas, Dallas). Nature (London); 250: No. 5467, 555-556(16 Aug 1974).

It has been suggested that the Tunguska event that occurred in Siberia in 1908 was caused by a black hole. About 10^{23} ergs (equivalent to 2 M ton of TNT) of energy were released by the explosion. Evidence is here discussed, however, favoring the idea that the event involved a body with characteristics like a cometary nucleus, rather than a black hole. The nature of the damage caused indicates that most of the energy went into an air explosion. By contrast, a typical solid Ni–Fe meteorite first buries below the surface and then dissipates its energy in a subsurface explosion. No significant excavation was caused by the Tunguska explosion, and it is suggested that the event was caused by a small cometary nucleus consisting of a mass of frozen gases mixed with Ni–Fe and silicate particles. The body would have had low cohesion and would have fragmented in the air and dissipated most of its kinetic energy before reaching the surface. Furthermore, if a black hole had been the cause it would have passed through the Earth and caused a similar explosion at the point of exit; microbaragraph records, however, show no sign of such an exit explosion. Other arguments against the black hole hypothesis are that the spatial pattern of the numerous small magnetic globules with high Ni content found in the Tunguska region indicates that the source of these extra terrestrial particles was the impact explosion, and a thick dust train along the path of the fireball immediately after its passage is consistent with the deposition of material in the atmosphere rather than loss of air into a black hole. Exceptionally bright nights observed are also consistent with the deposition of extra terrestrial material in the atmosphere at the time of the explosion. Measurements of atmospheric transparency are also in line with this view. The total mass of dissipated material is estimated as several million tons. (UK)

4365 FORMATION OF THE EARTH. Hutchison, R. (British Museum, London). Nature (London); 250: No. 5467, 556-558 (16 Aug 1974).

Recent hypotheses for the origin of the inner planets, based on chemical data obtained from meteorites or from solar observations, are discussed, followed by a suggested more direct approach based on reliable estimates of upper mantle composition. The proposed model for formation of the Earth is as follows: accretion commenced either as a metal-rich core followed by ordinary chondritic material, or as iron-rich ordinary chondrite material alone. Partial melting resulted in loss of siderophile and chalcophile elements from the silicate mantle to the core, and surface heating by a superluminous sun drove off volatiles, alkalis, and about 35% of the SiO_2 from the upper part of the primitive mantle. Addition of Cl material during protracted cooling then added Ni, alkalis and finally volatiles. (UK)

4366 SYNCHROTRON EMISSION FROM PARTICLES HAVING A TRUNCATED POWER-LAW ENERGY SPECTRUM. Gleeson, L. J.; Legg, M. P. C.; Westfold, K. C. (Monash Univ., Clayton, Australia). Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 379-397(Aug 1974).

The frequency spectrum has been determined of the synchrotron emission from ultra-relativistic electrically charged particles moving in a uniform magnetic field and having a power-law distribution in total energy E which has upper and lower limits E_1, E_2. Account is taken also of the fact that a single particle cannot radiate below its fundamental gyrofrequency. Series have been derived for the determination of the Stokes parameters and the results, presented as correction factors to be applied to the spectra determined by Legg & Westfold (Astrophys. J.; 154: 499 (1968)), which remain valid when the energy of maximum emissivity lies well within the range (E_1, E_2). In contrast with the linear form (on a log–log display) of the uncorrected spectra, the complete spectra have three characteristic linear sections when $E_2 = \infty$ and, in addition, when E_2 is finite, are confined between corresponding upper and lower frequencies. These three sections cover a wide range of frequencies, from $O(E_0^2/E_1^2)f_{c1}$ to $O(f_{c1})$ and above, where f_{c1} is the critical frequency corresponding to the lower cut-off energy E_1; in the lowest band they should be taken as indicating the trends of the spectra. Nevertheless, in a practical situation, observations of the transition frequencies between these sections would enable useful inferences about E_1 and the magnetic-field intensity to be drawn. The results of this paper provide the basis for determining the complete radiation spectrum in more complex cases of current interest, e.g. the radiation from electrons trapped in the dipolar magnetic field of the planet Jupiter. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

4367 (AD-773852) ION ACOUSTIC PARAMETRIC DECAY INSTABILITIES WITH STRONG ION LANDAU DAMPING. Technical Report, 20 February–1 October 1973. Flick, J. T.; Hendel, H. W. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1 Oct 1973. Contract F30602-73-C-0163. 37p. (RADC-TR-73-366). NTIS $5.00.

Collective plasma phenomena similar to those occurring in the ionosphere upon incidence of intense electromagnetic waves have been studied in laboratory Q-machine plasmas. In particular, the ion acoustic parametric decay instability, of special interest with regard to the ionosphere, has been studied since it causes strongly enhanced absorption of electromagnetic waves. (auth)

4368 (AD-781794) AIRCRAFT INFRARED MEASUREMENTS. Final Report, 1 October 1970–30 November 1973. Huppi, R. J.; Baker, D. J. (Utah State Univ., Logan (USA). Electro-Dynamics Labs.). 31 Jan 1974. Contract F19628-71-C-0059. 34p. (AFCRL-TR-74-0108). NTIS $3.25.

Infrared measurements of auroral, airglow, and artificial source emissions were planned and performed. The measurements were made with a near infrared (NIR) radiometer system and a cold chopper interferometer-radiometer system operating from an AFCRL KC-135 aircraft. Some support measurements were also performed from a ground-based station. These measurements were necessary for rocket support and future aircraft-borne measurement planning and correlation. To accomplish the desired measurements, it was necessary to periodically perform calibrations, inspections, and maintenance on the instrument systems. Optional modifications were designed and constructed for the NIR system to allow measurements of target sources in bright backgrounds and to allow narrow field of view measurements. In addition, a radiometer was designed and constructed to make infrared measurements at wavelengths from 2.9 to 4.9 micrometers. Finally, a design study of a radiometer for wavelength measurements from 1.4 to 4.9 micrometers was performed. (Modified Author Abstract)

4369 OBSERVATIONS AND TRAVELLING IONOSPHERIC DISTURBANCES AT LONDON, CANADA USING PHASE INTERFEROMETRY OF SOLAR RADIO EMISSIONS. Litva, J. London, Can.; Univ. of Western Ontario (1974). vp. National Library of Canada, Ottawa.

Thesis (Ph. D.).

A new technique for observing travelling ionospheric disturbances (TIDS) and determining their parameters is presented. It consists of the measurement of TID induced phase (angle of arrival) and amplitude variations of radio waves which propagated through the ionosphere from localized regions of enhanced emission on the sun. These measurements were made with solar radio interferometers operating on a frequency of 51.7 MHz. Theoretical expressions are derived which permit one to determine the following TID parameters from the interferometer measurements: (a) speed, (b) line of travel, (c) period, (d) wavelength, (e) height, (f) tilt, and (g) electron number density perturbations. Some observations of TIDS made at London, Canada are presented. They show good evidence of TID wave trains consisting of 15 to 18 wave cycles, whereas a survey of past observations suggests that at most four cycles have been observed in TID wave trains. The angular deflections of the solar line of sight at 51.7 MHz were measured to be between ±6 to ±28 minutes of arc — in one case it was a remarkable ±50 minutes of arc — corresponding electron number density perturbations are calculated to be of the order of 1 to 2 percent. The observed variations in amplitude corresponding to the larger angle-of-arrival scintillations were about 5 dB. The solar radio interferometer used to measure the angle-of-arrival deviations is shown to be a sensitive instrument for detecting TIDs in the ionosphere; capable of detecting TIDs with electron number density perturbations as low as one percent or less. The TIDs were observed as quasi-periodic scintillations in the angle-of-arrival of radio-waves emitted by localized disturbed regions on the solar disk. It is shown that the speed, line of travel, period and wavelength of the TIDs can be deduced from the manner in which the period and magnitude of the observed scintillations vary with time. The speed of the TIDs as a function of height is also determined by correlating the degree of amplitude fading due to defocusing and focusing effects with the maximum observed rate of change of angle-of-arrival. Theoretical expressions are derived for determining the angle-of-arrival of signals from one and two sources using a swept lobe interferometer. Experimental results showing deviations in the angle-of-arrival of a signal from the radio source Cassiopeia A are given and shown, by application of the two source theory, to be caused by interference with a signal from the radio source Cygnus A. In addition results are given of a laboratory simulation of an interferometer system monitoring two sources. These again show good agreement with theory. A lengthy digression is made based on the two source theory to show that the measured quasi-periodic scintillations were not produced by a mechanism other than TIDs. The sun, when emitting rf energy at an enhanced level, is shown to be an effective source for detecting TIDs. In effect, it tends to select time intervals, for the observer, when there is a good likelihood of TIDs being present in the ionosphere. TIDs tend to be present when the ionosphere is disturbed and the ionosphere tends to be disturbed when the sun is disturbed. The fact that the sun radiates at an enhanced level, only at times when it is in a disturbed state, completes this cause effect relationship. On the other hand it is not an effective source for obtaining synoptic measurements because measurements are possible only on those infrequent occasions when the sun is radiating at an enhanced level. The TIDs were observed on 18 days and were primarily of two types; one with a period of approximately 6 minutes, the other with the period of 21 minutes. The former travelled with the speed of about 200 km/hr and a corresponding wavelength of 20 km. The speed of the latter was between 800 and 2000 km/hr and the corresponding wavelength between 300 and 700 km; they also had a preferred line of travel which was oriented north-south. There is some evidence also of a TID with a wave period between 60 and 65 minutes. It is shown that the properties and parameters of the observed TIDs using the angle of arrival technique developed herein are consistent with observations of TIDs conducted by other workers using a variety of experimental techniques. Wave trains which are up to four times as long as the largest previously observed were observed and are documented in this thesis. In addition their properties are shown to be in agreement with those predicted by the gravity wave theory. (Diss. Abstr. Int., B)

4370 ENERGY DEPOSITION IN THE LOWER IONOSPHERE BY PRECIPITATING ELECTRONS. Rausaria, R. R.; Singh, R. N. (Banaras Hindu Univ., India). Indian J. Phys.; 48: No. 5, 416–420 (May 1974).

The test particle attenuation of charged particles gives an overestimate of energy deposition in the lower ionosphere. The attenuation of energy spectrum of energetic charged particles precipitating in the lower ionosphere has been invoked. The energy deposition in the lower ionosphere obtained from energy spectrum attenuation is found to be smaller. The electron-ion pair production rate obtained from this energy deposition rate is found to be consistent with available electron–ion production rate data. (auth)

4371 FIELD–ALIGNED AURORAL ELECTRON FLUXES. Arnoldy, R.L. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455); Lewis, P.B.; Isaacson, P.O. J. Geophys. Res. 79: No. 28, 4208-4221 (1 Oct 1974).

Out of a series of five auroral sounding rocket flights, electron fluxes in three of the flights were observed to be sharply field–aligned. The electrons were detected with an array of electrostatic analyzers making 50 point spectral samples from 0 to 15 keV. The field–aligned fluxes resulted in a peak in the spectrum at a lower energy than that of another monoenergetic peak in the spectrum seen consistently when it was conjugate to bright auroral forms giving multiply peaked spectra. The higher–energy peak was observed in all cases to be isotropic in pitch angle. The field–aligned peak in the spectrum is apparently a phenomenon distinct from the isotropic peak and was observed to occur at various times in the energy range from a few hundred electron volts to 5 keV. The field–aligned electrons were highly collimated having pitch angles less than 20° and at times less than 10°. During one flight the field–aligned fluxes were also very monoenergetic. The high degree of field alignment and the monoenergetic character support the model that these events can be attributed to relatively cool plasma falling through an electric potential at altitudes not too far removed from the rocket. (auth)

4372 BACKSCATTER FROM A POSTULATED PLASMA INSTABILITY IN THE POLAR CAP IONOSPHERE AND THE DIRECT MEASUREMENT OF A HORIZONTAL E REGION CURRENT. Primdahl, F. (Geophysical Department II, Danish Meteorological Institute, Copenhagen, Denmark); Olesen, J.K.; Spangslev, F. J. Geophys. Res. 79: No. 28, 4262-4268 (1 Oct 1974).

Previosuly published data by L. J. Cahill, Jr., from a rocket measurment of a horizontal polar E region sheet current have been further analyzed by using nearby ground–based magnetograms and ionograms. The combined data indicate that the requirements of the

Farley—Buneman two—stream instability were fulfilled and give further support to the hypothesis that a plasma instability is revealed by the so—called 'slant E condition' on the ionograms previously described. (auth)

4373 CURRENT SYSTEM IN AN AURORAL SUBSTORM. Kintner, P.M.; Cahill, L.J. Jr. (School of Physics and Space Science Center, University of Minnesota, Minneapolis, Minnesota 55455); Arnoldy, R.L. J. Geophys. Res. 79: No. 28, 4326-4330 (1 Oct 1974).

An instrumented sounding rocket was launched at 0040 LT into the expansive phase of an auroral substorm on March 16, 1973, from Poker Flat, Alaska. This report describes coordinated measurements of electric field, magnetic field, and energetic electrons. By comparing the observed magnetic field with that predicted by model currents, a current system, which includes field—aligned currents, is deduced. The model indicates three currents: a southward current of 14.37 $\mu A/m^2$, a westward current of 22.5 $\mu A/m^2$, and two field—aligned currents of 5 $\mu A/m^2$. A southward electric field of 60 mV/m identifies the southward current as a Pedersen current and the westward current as a Hall current. The field—aligned current measured from particle detectors shows a structure similar to that in the magnetic model. The total field–aligned electron current measured by particle detectors agrees within 10% of the current model. (auth)

4374 PARAMETRIC EXCITATION OF PLASMA WAVES IN THE REGION OF RADIO-WAVE REFLECTION FROM THE IONOSPHERE. Shvartsburg, A. B. (Inst. of Terrestrial Magnetism, Ionosphere and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 24-28(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 31-35(1974).

Equations are obtained that describe the parametric excitation of plasma waves in the region of reflection of an extraordinary wave from the ionosphere during vertical sounding. The threshold values of the amplitude of the radio-wave field are found for periodic and aperiodic buildup of oscillations. The effect on the threshold amplitude of the "swelling" of the field in the region of reflection and focusing of the beam in an anisotropic ionosphere is investigated. (auth)

4375 INDUCED RADIO-WAVE SCATTERING IN THE IONOSPHERIC F LAYER. Mityakov, N. A.; Rapoport, V. O.; Trakhtengerts, V. Yu. (Gorki Radio Physics Inst., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 29-35(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 36-43(1974).

Processes arising from the effect of a strong radio emission on the ionospheric F layer are investigated. The decisive role of the induced scattering of transverse waves on ions with transformation to plasma waves is demonstrated. The plasma wave spectrum forms under stationary conditions as a result of nonlinear energy transfer toward large scales. Theoretical computations agree well with experimental data at Arecibo. (auth)

4376 EFFECTIVE RECOMBINATION COEFFICIENT IN THE LOWER IONOSPHERE. Leonov, V. I. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 36-38(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 44-47(1974).

The zonal wind and the gradient of the electron density profile in the ionosphere are taken into account in the quasi-hydrodynamic approximation. It is demonstrated that the nature of the effective recombination coefficient measured in the lower ionosphere is nonchemical. (auth)

4377 SELECTION OF THE BEST APPROXIMATION OF THE N(h) PROFILE AND ITS DERIVATIVE FOR COMPUTING THE VIRTUAL HEIGHTS OF THE IONOSPHERE. Gulyaeva, T. L. (Inst. of Terrestrial Magnetism, Ionosphere and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 39-42(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 48-52(1974).

The piecewise-linear and parabolic approximations of the N(h) profile, given by discrete points, are compared. It is demonstrated that the parabolic model is unsuitable for computing h′(f). A method for computing h′(f) curves is proposed. It is based on the approximation of N(h) by overlapping parabolas, best describing the density distribution of electrons and its derivative. (auth)

4378 CHECK OF THE CORRECTING METHOD OF COMPUTING N(h) PROFILES FROM TEST MODELS. Mal'tseva, O. A. (Rostov State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 43-45(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 53-56(1974).

The correcting method is used to check the computation of N(h) profiles. Quantitative estimates, defining the accuracy of the method, are presented. (auth)

4379 CONDUCTIVITY OF THE POLAR IONOSPHERE, CREATED BY AURORAL ELECTRONS. Turbin, Yu. G.; Van'yan, L. L.; Gal'perin, Yu. I.; Osipova, I. L.; Spivak, V. A.; Fedorova, N. I. (Inst. of Terrestrial Magnetism, Ionosphere and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 54-58(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 67-72(1974).

The spectra of auroral electrons with energies 0.03 to 150 keV were obtained on Kosmos 261 in the region of the negative electrojet, in the precipitation region near the day cusp, and in the polar cap during the period of moderate magnetic activity of December 23-24, 1968. These data are used to compute ionization rate and electron density profiles at heights of 90 to 200 km for the Northern (winter) Hemisphere, and the integral Hall and Pedersen conductivities are determined. (auth)

4380 NONSTATIONARY ION PRODUCTION BY THE AURORAL IONOSPHERE. Bagno, Yu. D.; Osipov, K. K.; Osipov, N. K. (Inst. of Terrestrial Magnetism, Ionosphere and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 59-62(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 73-77(1974).

It is demonstrated that the time of establishment τ_a and the relaxation time τ_r of electron density n_a differ from each other and from the accepted value of $\Delta t = (2\alpha_{eff}n_a)^{-1}$ for a stepwise change in the ionization function. Curves of τ_a and τ_r are presented for various heights. (auth)

4381 ROLE OF THE RADIATIVE ASSOCIATION REACTION OF ATOMIC OXYGEN IN THE EARTH'S ATMOSPHERE. Murtov, B. A. (Inst. of Applied Geophysics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 63-66(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 78-82(1974).

It is demonstrated, on the basis of present views on the magnitude of O_1 fluxes in the upper atmosphere, that these fluxes have practically no distorting effect on the photochemical oxygen equilibrium at heights of ~220 km. The reaction rate coefficient of the radiative association of oxygen atoms in the earth's atmosphere is estimated at $\alpha \approx 10^{-17}$ cm^3 sec^{-1}. (auth)

4382 THREE-DIMENSIONAL ANALYTICAL MODEL OF THE DISTRIBUTION OF EFFECTIVE ELECTRON COLLISION FREQUENCY IN A QUIET IONOSPHERE. Gayvoronskaya, T. V.; Soboleva, T. N.; Tushentsova, I. A.; Tsedilina, E. E. (Inst. of Terrestrial Magnetism, Ionosphere and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 19-23(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 25-30(1974).

A global analytical model is proposed for the distribution of the effective number of electron collisions ν_e in a quiet ionosphere. The model covers the height interval 50 to 700 m. (auth)

4383 GENERATION AND NATURAL FREQUENCIES OF π2 PULSATIONS. Mal'tsev, Yu. P.; Leont'ev, S. V.; Latskii, V. B. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 101-107(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 124-131(1974).

A mechanism of π2 generation is proposed in which the agent triggering the oscillations of a force tube is the ionosphere. The reflection coefficient of resonant waves from an inhomogeneously conducting ionosphere is computed and the resonance frequency spectrum is found. This spectrum consists of nonmultiple, but equidistant, elliptically polarized harmonics. (auth)

4384 DP2 CURRENTS SYSTEM AND ITS PLACE IN THE DEVELOPMENT OF A SUBSTORM. Leont'ev, S. V.; Lyatskii, V. B.; Mal'tsev, Yu. P. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 91-96(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 112-118(1974).

The total magnetic effect of longitudinal and ionospheric currents developing during the appearance of the convection electric field is computed with allowance for the different conductivity of the day and nighttime ionosphere. The resultant equivalent ionospheric current system coincides with a current system of the DP2 type. (auth)

4385 ION-ACOUSTIC WAVES IN A MAGNETOACTIVE PLASMA CONTAINING TWO KINDS OF IONS. Ryabov, B. S. (Inst. of Terrestrial Magnetism, Ionosphere and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 130-132(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 155-158(1974).

The dispersion equation of ion-acoustic waves is investigated in a magnetoactive plasma containing two kinds of ions. For the sake of illustration, some numerical values of plasma parameters that may occur in the topside ionosphere are examined. (MHR)

4386 ERRORS IN THE DETERMINATION OF THE LOSS COEFFICIENT IN THE F REGION OF THE IONOSPHERE. Berishvili, G. P.; Mebagishvili, N. N.; Khocholava, G. M. (Inst. of Geophysics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 133-134(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 159(1974).

Using the data from Washington and Moscow during the solar activity maximum (1958) and minimum (1964), values of the loss coefficient β were obtained for fixed heights at different geomagnetic activity levels, which vary within $(0.3-2.0) \cdot 10^{-4}$ sec^{-1} (quiet conditions) and $(0.7-3.3) \cdot 10^{-4}$ sec^{-1} (disturbed conditions). These results agree well with the β values obtained by others. The value of β depends on a large number of parameters which are variable in time and height. The errors of calculations by the proposed method are investigated. (MHR)

4387 STRUCTURE OF MIDLATITUDE E_s FROM ROCKET AND GROUND-BASED RADIO SOUNDING DATA. Korsunova, L. P. (Siberian Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Irkutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 134-136(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 160-161(1974).

The results of 20 rocket measurements of the electron density, n_e (h) (Wallops Island, 37°05′N; 75°50′W), made simultaneously with ground-based vertical soundings are examined. The main parameters of the observed sporadic layers are given. It is concluded that the majority of reflections from E_s at frequencies exceeding plasma frequencies are produced by electron density gradients. Scattering of radio waves on E_s inhomogeneities is evidently responsible for semitransparent regions $\Delta FE_s \geq 3$ MHz. (MHR)

4388 DETERMINATION OF THE PARAMETERS OF TRAVELING IONOSPHERIC DISTURBANCES BY THE D1 METHOD. Drobzhev, V. I.; Kudelin, K. M.; Nurgozhin, B. I.; Pelenitsyn, G. M.; Troitskii, B. V. (Ionospheric Sector, Alma-Ata, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 136-138(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 162-164(1974).

A method was described previously for determining the magnitude and direction of vertical velocity, and the wavelength and period of traveling ionospheric disturbances by synthesis of polarization fading for different frequencies, obtained with allowance for the dispersion of the ionosphere and the effect of the magnetic field. The preliminary results of computations using disturbances in the form of a vertical traveling wave are presented. Since under real conditions the wave vector of a disturbance can be oriented arbitrarily in space, it becomes necessary to develop a method for determining the horizontal parameters of traveling disturbances simultaneously with the vertical parameters. For this purpose, polarization fading was calculated, representing a model of an experiment of frequency-space diversity reception with a small base. (MHR)

4389 SEASONAL VARIATIONS OF CHARGED-PARTICLE DENSITY IN THE UPPER IONOSPHERE. Egorova, T. V.; Kutimskaya, M. A. (Irkutsk State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 138-140(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 165(1974).

The behavior of charged particles in different seasons, obtained from the solution of the dynamic model of ionospheric-plasmaspheric interactions along a midlatitude force tube, is examined. A system of partial differential equations, consisting of two continuity equations for oxygen and hydrogen ions and a thermal conductivity equation for electrons, was solved. Boundary conditions were selected at the 120-km level on both ends of the tube. Jacchia's 1970 model of the neutral atmosphere was selected as initial data. Using his method, the gas composition was computed for three seasons, i.e., summer, equinox, and winter, during the solar activity minimum. (MHR)

4390 REGULAR COSMIC RADIO NOISE ABSORPTION IN THE POLAR IONOSPHERE. Lukashkin, V. M. (Artic and Antarctic Scientific Research Inst., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 142-143(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 168-169(1974).

Information on regular cosmic radio noise absorption at two points equidistant from the poles and located in opposite hemispheres is presented. The possibility of superposition of instrumental effects owing to a change in climatic characteristics with a similar temporal rhythm was studied. (MHR)

4391 SC-ASSOCIATED EFFECTS IN AURORAS. Vorob'ev, V. G. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 72-74(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 90-92(1974).

The development of SC- and SI-associated effects in auroras is investigated from the global network of all-sky cameras. It is demonstrated that an SC (SI) is accompanied by a brief increase in auroral activity (3 to 8 min) in the auroral zone, which is observed in a broad range of longitudes, with the strongest increase occurring at 67 to 70° of corrected geomagnetic latitude. A scheme of the development of the SC effect in auroras is constructed. (auth)

4392 OPTICAL EFFECTS OF SC AND SI AT LOPARSKAYA AND MIRNY. Roldugin, V. K. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 75-76(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 93-95(1974).

From photometric records at Loparskaya it was found that SC and SI can be accompanied both by an increase and a decrease of airglow. This effect has not been detected at Mirny, but auroras appeared 15 min after an SC. (auth)

4393 QUALITATIVE EXAMINATION OF THE EFFECT OF SYSTEMATIC TILTS, IN THE IONOSPHERE, ON HF BEARING MEASUREMENTS. Morgan, A. D. (Government Communications Headquarters, Cheltenham, Eng.). J. Atmos. Terrest. Phys.; 36: No. 10, 1675-1681(Oct 1974).

The effect of systematic tilts, in the ionosphere, on HF bearing measurements taken over a 3 week period in both spring and summer, are examined qualitatively. The results suggest that the behavior of these tilts is dependent on the solar zenith angle. (auth)

4394 GEOMAGNETIC EFFECTS ON THE F-REGION OF THE IONOSPHERE. Stening, R. J.; Chance, M. P. (West Indies Univ., Mona, Jamaica). J. Atmos. Terrest. Phys.; 36: No. 10, 1663-1673(Oct 1974).

The effects of geomagnetic activity on F-region ionization are investigated by calculating correlations between F-region parameters and the Kp-index, including delays of up to 33 hours. At Kingston, Jamaica, total electron content values are used, while at Ottawa, Churchill and Resolute Bay, tabulated values of foF2 are subjected to correlation. The correlations are evaluated for each hour of the day in groups of two months so that seasonal variations can also be detected. Results indicate that it may be possible to separate geomagnetic effects according to whether the lag between Kp and the ionospheric effect is short (0 to 6 h), medium (9 to 18 h), or long (21 to 30 h). The various processes which might correspond to these categories are discussed and applied to the results from the four stations mentioned above. (auth)

4395 ENERGY SPECTRA MEASURED DURING A RELATIVISTIC ELECTRON PRECIPITATION EVENT ON 2 FEBRUARY 1969. Larsen, T. R. (Norwegian Defence Research Establishment, Kjeller); Thomas, G. R. J. Atmos. Terrest. Phys.; 36: No. 10, 1613-1622(Oct 1974).

Energy spectra have been measured during the relativistic electron precipitation event of 2 February 1969 by the polar-orbiting satellite ESRO 1A. Precipitated electrons were measured in six integral channels from >48 keV to >434 keV, the data being obtained in the local morning time sector. The highest energy electrons (>434 keV) were detected only from 63° to 70° invariant latitude. Assuming exponential energy spectra, e-folding energies of about 50 keV were deduced for the precipitated electrons with energies >176 keV. (auth)

4396 ENERGETIC ELECTRONS IN THE MIDLATITUDE NIGHTTIME E-REGION. Smith, L. G.; Geller, M. A.; Voss, H. D. (Illinois Univ., Urbana). J. Atmos. Terrest. Phys.; 36: No. 10, 1601-1612(Oct 1974).

Nike Apache 14.439 was launched from Wallops Island at 0003 EST on 1 November 1972, a very disturbed night (Kp = 8). A Geiger counter in the payload detected electrons (>70 keV) with a maximum flux of 1086 ± 26 cm^{-2} sec^{-1} ster^{-1}. The height-averaged ionization rate in the upper E-region is calculated from the measured electron density profile and has a value of 35 cm^{-3} sec^{-1}. The ionization rate on this and four other nights is found to be strongly dependent on geomagnetic activity and is well represented by $q = 0.14 \exp(0.71\ Kp)$ cm^{-3} sec^{-1} for values of Kp between 0^+ and 8. It is suggested that energetic electrons are the principal source of ionization at midlatitudes in the upper E-region near midnight, even under rather quiet geomagnetic conditions. (auth)

4397 EXCITATION OF THE EARTH-IONOSPHERE WAVEGUIDE BY DOWNGOING WHISTLERS. II. Propagation in the Magnetic Meridian. Walker, A. D. M. (Natal Univ., Durban, South Africa). Proc. Roy. Soc. (London), Ser. A; 340: No. 1622, 375-393(24 Sep 1974).

The excitation of the Earth-ionosphere waveguide by a downgoing whistler with wave normal in the magnetic meridian is discussed. It is suggested that the wave normal is scattered into the acceptance cone by spread-F irregularities. The model of the ionosphere used is a slowly varying magnetoionic medium terminated by a sharp boundary at the bottom. The ground is treated as a perfect conductor. Reflexion and coupling coefficients are defined and derived. It is shown that for some angles of incidence the signal is trapped in the waveguide. The range in the waveguide is computed as a function of angle of incidence. The properties of the waveguide modes are discussed, and their excitation for a plausible incident signal is computed. It is shown that the least attenuated modes are very weakly excited while those modes which are strongly excited are rapidly attenuated. This explains why the field of view of a receiver is limited to about 15° of latitude. (auth)

4398 APPROXIMATE MODE CONVERSION COEFFICIENTS IN THE EARTH-IONOSPHERE WAVEGUIDE FOR VLF PROPAGATION BELOW AN ANISOTROPIC IONOSPHERE. Smith, R. (City of Leicester, Polytechnic, Eng.). J. Atmos. Terrest. Phys.; 36: No. 10, 1683-1688(Oct 1974).

The Earth-ionosphere waveguide is considered to be a parallel plate waveguide whose upper and lower boundaries are characterized by constant impedance matrices. Simple orthogonal relations between the resulting modes are found and used to obtain an approximate formula for the mode conversion coefficients at a land–sea discontinuity. Some numerical results are given for propagation below an anisotropic ionosphere in which the QL approximation is valid. These results are similar to those for the propagation of TE, not TM, modes below an isotropic ionosphere. (auth)

4399 INTENSITY OF THE NEAR INFRARED OH AIRGLOW. Hofmann, W.; Frey, A.; Lemke, D. (Max-Planck-Institut fuer Astronomie, Heidelberg). Nature (London); 250: No. 5468, 636-637(23 Aug 1974).

The OH airglow was studied with a balloon-borne telescope on three flights launched in 1971 and 1972 from the NCAR balloon flight station in Texas. Measurements were made at an altitude of 32 km at wavelengths 0.82, 2.1 and 2.4 μm. A straightforward photometer was employed for the shorter wavelengths with a multiplier as detector; for the longer wavelengths a dry ice-cooled PbS photometer was used. Zenith intensities are shown tabulated, and results are compared with those of other investigators. The measurements indicated that at 2.4 μm the airglow intensity was at least three times smaller than previously estimated. A patchy structure was observed at 0.82 and 2.1 μm, the patches having diameters of about 10° to 20°, corresponding to 28 to 40 km in linear size, and differing from the average intensity by up to 20%. The results confirmed the existence of a theoretically predicted gap in the OH airglow emission at 2.4 μm. Because of the large intensity and the irregularities of the airglow at shorter wavelengths, serious problems arise in subtracting the airglow foreground from the night sky radiation. (UK)

4400 SOLAR FLARES AND D-REGION IONIZATION SOURCES AT HIGH ZENITH ANGLES. Gough, M. P. (Univ. Mackenzie, Sao Paulo, Brazil). J. Atmos. Terrest. Phys.; 36: No. 10, 1695-1699(Oct 1974).

VLF phase measurements were made at three locations along the same great circle path of propagation during a solar flare which occurred on 29 June 1973. The termination for the solar flare effect on the ionosphere at VLF-reflecting heights occurred between solar zenith angles 84° and 87°, considerably less than the sunset zenith angle of 94° for this height. Ionization production is considered for the various ionization sources as a function of zenith angle. The measurement is consistent with the electron density at VLF-reflecting heights being primarily controlled by solar photo-detachment; but at zenith angles greater than 76° the ionization available for photo-detachment is produced by scattered Lyman-α, as the direct Lyman-α becomes too heavily absorbed. (auth)

4401 EXCITATION OF THE EARTH-IONOSPHERE WAVEGUIDE BY DOWNGOING WHISTLERS. I. Isotropic Model. Walker, A. D. M. (Natal Univ., Durban, South Africa). Proc. Roy. Soc. (London), Ser. A; 340: No. 1622, 367-374(24 Sep 1974).

A simple isotropic model of the lower ionosphere is used to illustrate the mathematical techniques necessary for a theoretical discussion of how a downgoing whistler excites the Earth-ionosphere waveguide. The physical interpretation of the results is made clear. They are qualitatively the same as those obtained for a more realistic model in an accompanying paper (Proc. R. Soc. Lond. A.; 340: 375-393(1974)). (auth)

4402 EVIDENCE OF ENERGY DEPENDENT MECHANISMS FOR THE PRECIPITATION OF AURORAL ELECTRONS. Bosqued, J. M.; Reme, H. (Univ., Toulouse). Planet. Space Sci.; 22: No. 9, 1279-1288(Sep 1974).

This paper discusses the experimental results on electron precipitation in a diffuse aurora obtained by a sounding rocket launched from ANDENES ($L \sim 6.2$) on 3 November 1968. A considerable increase in the intensity of low-energy electrons, $E_e \lesssim 5$ keV, followed a large precipitation of more energetic electrons, $E_e \gtrsim 5$ keV. From the observation of angular distributions and an estimate of the diffusion coefficient ($D_\alpha \gtrsim 10^{-3}(\mathrm{sec})^{-1}$), it is suggested that this higher-energy precipitation is induced by gyroresonant interactions of magnetospheric electrons with radiation in the whistler mode. The lower-energy precipitation, separated in time and/or space, shows quasi-periodic modulations in the 5 to 15 sec range with periods close to the bounce period. It is suggested that this precipitation is the result of bounce-resonance interactions with electrostatic waves in the equatorial plane. Finally, from a comparison between the experimental energy spectra and plasma sheet spectra it can be concluded that these electrons are injected from the plasma sheet during a substorm and are then diffused and precipitated by energy-dependent mechanisms. (auth)

4403 MID-LATITUDE PULSATING AURORAS. Hall, W. N. (Air Force Cambridge Research Labs., Bedford, MA). Planet. Space Sci.; 22: No. 9, 1315-1321(Sep 1974).

Pulsating auroras were recorded at Bedford, Massachusetts, cgm lat. 55.4°, 24 March 1969 during a worldwide magnetic storm, the only known published observations of pulsating auroras at such low magnetic latitudes. Spectral density analysis of several minutes of 5577A pulsations indicated a dominant period of 7.2 sec at 0300 EST. The following characteristics were noted: (1) occurrence during a negative bay in H; (2) location toward the equatorial boundary of the auroral display; (3) occurred a few hours after local midnight; (4) characteristic period of 6 to 10 sec; (5) quasi-sinusoidal or superposition of sinusoids rather than isolated pulses; (6) modulation of the background intensity by 15 to 30%. These characteristics have previously been observed by others in pulsating auroras in the auroral oval. Other mid-latitude geophysical measurements at the same time show similarities to typical auroral oval behavior. These observations indicate that the auroral oval expanded during the worldwide magnetic storm until the boundary of the auroral oval was near cgm latitude 55°. If this observation of one mid-latitude pulsating aurora is in general valid, then the agreement of the characteristic period of pulsating auroras when the oval has expanded to mid-latitudes with the period of pulsating auroras when the oval is not expanded should be useful in distinguishing between proposed source mechanisms for these pulsating auroras. (auth)

4404 ELECTRON CONTENT MEASUREMENTS OF EQUATORIAL ANOMALOUS IONOSPHERE USING THE GEOSTATIONARY SATELLITE SIGNALS. Kaushika, N. D. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil). Planet. Space Sci.; 22: No. 9, 1309-1314(Sep 1974).

Measurements of electron content (N_T) near the crest of the equatorial ionosphere anomaly in South America have been made and analyzed to investigate N_T variations with solar hour, solar rotation and geomagnetic storms. The annual mean of diurnal ratio, defined as the ratio of the maximum to the minimum electron content of the day, is found to be 5.0. Anomalous increases in night time electron content are observed with maxima around 2100 LMT and 2300 LMT during summer and equinoctial months. These increases are found to be linked with vertical motion of the F-layer. Spatial resonance in equatorial F-layer plasma appears to be the possible cause of these increases. (auth)

Magnetospheric Phenomena

4405 (AD-779693) HIGH RESOLUTION POWER SPECTRAL ESTIMATE: THE MAXIMUM ENTROPY METHOD. Air Force Surveys in Geophysics. Radoski, H. R.; Fougere, P. F.; Zawalick, E. J. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 13 Feb 1974. 25p. (AFCRL-AFSIG-282; AFCRL-TR-74-0088). NTIS $3.00.

A new spectral estimate, the maximum entropy method, is described. In the maximum entropy method, the entropy change of a signal is maximized under the constraint that the autocorrelation function is the Fourier transform of the spectral power density. The problem reduces to specifying a unit-distance prediction error filter or, equivalently, a whitening filter. The spectral estimates are calculated in two ways: (1) by minimizing the error power to obtain the coefficients of the prediction error filter, as suggested by Burg and (2) by a direct solution of the matrix equation using an algorithm due to Levinson. These results are compared with a modified Blackman–Tukey technique, calculated with a Hamming window. Applications of the maximum entropy method to geomagnetic micropulsations and to the annual sunspot number are shown. (GRA)

4406 Kp DEPENDENCE OF THE PLASMA SHEET BOUNDARY. Freeman, J.W. (Department of Space Physics and Astronomy, Rice University, Houston, Texas 77001). J. Geophys. Res. 79: No. 28, 4315-4318 (1 Oct 1974).

An empirical relationship has been obtained between the location of the inner boundary of the plasma sheet along the geostationary orbit and Kp. Through the use of an analytical expression for the shape of the boundary and a relationship between the convection electric field and Kp this result is extended to yield the radial position of the boundary versus Kp. The result illustrates the high degree of sensitivity of measurements in the geostationary orbit region to shifts in the plasma sheet position arising from geomagnetic activity or an increasing convection electric field. (auth)

4407 THE PROTON RING CURRENT AND ITS INTERACTION WITH THE PLASMAPAUSE: STORM RECOVERY PHASE. Williams, D.J.; Lyons, L.R. (Space Environment Laboratory, NOAA/ERL, Boulder, Colorado 80302). J. Geophys. Res. 79: No. 28, 4195-4207 (1 Oct 1974).

Using data from the Explorer 45 satellite, we have studied the interaction of the proton ring current with the plasmapause during the December 17, 1971, geomagnetic storm. This study concentrates on the storm recovery phase. The observed spatial, pitch angle, and energy distributions are shown for the near–midnight proton ring current for prestorm quiet, main phase, and recovery phase. Initial measured distribution functions $f(v_\perp, v_\parallel)$ are also shown. During recovery phase at altitudes just above the plasmapause, ring current protons exhibit a pitch angle distribution that is nearly isotropic except for an empty loss cone. As the plasmapause is approached, this distribution switches rapidly to one that is peaked near $\alpha=\pi/2$. We conclude that during recovery phase there exists a region just above the plasmapause in which the hot ring current plasma is stably trapped with negligible losses due to pitch angle scattering. As the plasmapause region is approached, moderate pitch angle diffusion is initiated. The spatial, energy, and time dependence of this process, its analysis via the resonant energy equation, and a comparison with an in situ estimate of the cold plasma density strongly indicate that scattering by ion cyclotron waves is the cause of the pitch angle diffusion. We thus further conclude that amplification of ion cyclotron waves by the interaction of the hot ring current plasma with the cold plasmaspheric plasma in the region of the plasmapause is an important loss process for the ring current particles during storm recovery phase. The energy range over which this process occurs is from ~1 keV to several hundred keV. Low–altitude observations of low–energy protons through the local loss cone are consistent with an included in this picture of recovery phase processes. (auth)

4408 MECHANISM OF ELECTRON PRECIPITATION IN THE MORNING AND AFTERNOON MAGNETOSPHERE. Sergeev, V. A.; Shumilov, O. I. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 150-152(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 176-177(1974).

The intensities of anomalous absorption bays at College were compared with the intensity of trapped electrons in the range of E ~ 50 to 150 keV on the ATS-1 satellite in 1966–1967. Here, cases are dealt with when the intensity and form of pitch-angle distribution at the boundary of the loss cone remain practically unchanged as the cone fills up. The results obtained here show that the dynamics of the auroral absorption region in the morning and evening magnetosphere is determined by the drift of a cloud of trapped electrons ($E \gtrsim$ keV) in which an instability develops of the type described by Kennel and Petcheck [J. Geophys. Res., 1966, 71, 1]. (MHR)

4409 EFFECT OF IONOSPHERIC CONDUCTIVITY ON THE CONVECTION SYSTEM IN THE MAGNETOSPHERE. Mal'tsev, Yu. P. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 128-129(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 154(1974).

An attempt to estimate quantitatively the role of ionospheric conductivity in creating a self-consistent magnetospheric electric field is presented. (MHR)

4410 DETERMINATION OF THE PARAMETERS OF MAGNETIC DRIFT SHELLS AND OF PARTICLE DISTRIBUTION IN THE MAGNETOSPHERE. Kasimov, U.; Shabanskii, V. P. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 77-80(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 96-99(1974).

Approximation formulas are presented that associate the parameters of magnetic drift shells L_d and α_d (equatorial distance and pitch angle) on the day side with the parameters of the same shell, L_n and α_n, on the night side. The formulas are applicable to the entire region $5 < L < 10$. (auth)

4411 ANALOG MODEL WITH A RESPONSE OF TYPE D_{st}. Krymskii, G. F.; Plotnikov, I. Ya. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 81-85(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 100-105(1974).

A functional model that describes the combination of properties manifest in a nonstationary relation between the solar wind and geomagnetic field parameters is investigated. A formal approach to the description of the D_{st} variation is proposed. (auth)

4412 CHARACTERISTICS OF THE DEVELOPMENT OF GIGANTIC DP2 VARIATIONS DURING MAGNETIC STORMS. Tverskaya, L. V.; Khorosheva, O. V. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 86-90(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 106-111(1974).

Some characteristics of the development of magnetic storms associated with quasi-periodic global magnetic field disturbances are investigated. The variations are quasi-harmonic. The possible relation between the phenomena observed and the variations of low-energy protons in interplanetary space is discussed. (auth)

4413 11-YEAR PERIODICITY IN THE HORIZONTAL COMPONENT OF THE GEOMAGNETIC FIELD. Rivin, Yu. R. (Inst. of Terrestrial Magnetism, Ionosphere and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 97-100(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 119-123(1974).

Double smoothing by a moving average is used as a filter to separate 11-year variations of the H component of the magnetic field. It is demonstrated that such a filter is more optimal than the single smoothing filters used earlier. The space and time distribution of the amplitudes of the 11-year variations of H obtained are investigated and a hypothesis is presented regarding the nature of these variations. (auth)

4414 ACCUMULATION OF ALBEDO PARTICLES IN THE GEOMAGNETIC FIELD AT MIDDLE LATITUDES. Gorchakov, E. V.; Getselev, I. V.; Severinov, V. I. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 122-123(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 148(1974).

The motion of albedo particles in the stationary geomagnetic field, given in the form of a central dipole, is examined. The results of computations for the magnetic shell $L = 3$ at intervals of 30° with respect to θ and φ are presented below for protons with E_p = 600, 800, 1000, and 1200 MeV (where θ is the angle at the injection point between the projection of the velocity vector onto the plane perpendicular to the magnetic field and the line of intersection of this place with the meridional plane). The trajectory was computed up to the instant of intersection of a particle with the surface of the earth or its escape beyond the boundary of the geomagnetic field. (MHR)

4415 INTERPLANETARY MAGNETIC FIELD, SOLAR FLARES AND GEOMAGNETIC DISTURBANCES. Afanas'eva, V. I. (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 1, 147-150(1974).

Translated from Geomagn. Aeron.; 14: No. 1, 175(1974).

The relation is examined between the change in the direction of the interplanetary field and flares (as characteristics of solar activity) followed by geomagnetic storms and disturbances. Data on 232 flares and on the radial and southward components of the interplanetary field for 1965-67 are used. One of the most active of many flares from a single region during a single day was used. Taking into account the dependence of the degree of geoactivity on solar latitude, flares were used in the interval of ±35° from the central meridian of the sun. The average characteristics of flux velocities were obtained from the log (in days) of the changes in the direction of the magnetic field after the day of the flares. (MHR)

4416 MODEL OF THE MAGNETOSPHERIC SUBSTORM. Johnston, A. D. (Mullard Space Science Lab., Dorking, Eng.). Nature (London); 250: No. 5467, 552-553(16 Aug 1974).

It is stated that it is generally recognized that the Earth's magnetic tail and the plasma sheet play an important role in the processes responsible for what is known as the "magnetospheric substorm". Models are discussed and a new model is proposed. The main features of this model are that the plasma sheet is formed on closed field lines and moves inward during the growth phase. The magnetic field line reconnection across the neutral sheet occurs on the lobe field lines and is essentially continuous, but is not directly responsible for the expansion phase, which is the result of an interchange type of instability, with the plasma sheet expending on to empty closed field lines. (UK)

4417 DISCRETE PARTICLE EFFECTS IN WHISTLER SIMULATION. Denavit, J. (Northwestern Univ., Evanston, IL). J. Comput. Phys.; 15: No. 4, 449-475(Aug 1974).

A particle code was written using weighted particles and a quiet start technique to simulate the nonlinear propagation of whistler waves parallel to an external magnetic field. The algorithm is derived from the Darwin Lagrangian by a variational method and two versions of the code are considered, using linear and quadratic splines. Numerical effects due to the discrete initial loading of the particles in parallel velocities, perpendicular velocity phase angles and positions are analyzed; and the performance of the linear and quadratic versions of the code are compared. (auth)

4418 GROUP REFRACTIVE INDEX EQUATION FOR WHISTLER MODE PROPAGATION THROUGH DRIFTING MAGNETOPLASMA. Agarwal, D. C. (Tohoku Univ., Sendai). Chin. J. Phys. (Taiwan); 12: No. 1, 32-34(Apr 1974).

Wave propagation in the whistler mode through a drifting magnetoplasma is studied. An expression for the group refractive index for such a propagation was derived, and calculations were made for a certain electron density model. It is shown that, for large values of Z, the group refractive index becomes independent of magnetic field. (2 figures) (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 4237, 4435, 4537, and 5476.

4419 (AD-782096) CALCULATIONS OF THICK TARGET X RADIATION FOR CONTINUUM ELECTRON BEAMS INCIDENT UPON ALUMINUM, COPPER, MOLYBDENUM, AND TUNGSTEN TARGETS. Final Report, May 1972–Apr 1974. Johnson, D. J. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Jul 1974. 20p. (AFWL-TR-74-130). NTIS $3.00.

A Monte Carlo electron beam transport program is used to calculate thick target x-ray spectra for use when interpreting x-ray spectral data from plasma generators possessing superthermal electron components. Spectra are calculated for various monoenergetic and continuum electron beams between 5 and 300 keV normally incident upon Al, Cu, Mo, and W targets. Calculations are presented at detection angles of 95, 105, 115, 135, and 175 degrees with respect to the electron beam direction. (auth)

4420 (IPNO-73-05) PROGRAM FOR CALCULATING ELECTRON IMPACT IONIZATION. Application to a Confined Heavy Ion Source. Baron, E. (Paris-11 Univ., 91–Orsay (France). Inst. de Physique Nucleaire). Nov 1973. 16p. (In French). Dep. NTIS (US Sales Only) $4.00.

A fixed number of neutral atoms contained in a given volume being bombarded with a monoenergetic electron beam, the charge state distribution is studied as a function of time. The continuous replenishment of the volume with neutral atoms is taken into consideration. This calculation is applied to confined multicharged heavy ion sources. (FR)

4421 CHARGED PARTICLE CONCENTRATION DISTRIBUTION IN AN ION-SOURCE PLASMA WITH OSCILLATIONS OF ELECTRONS IN THE MAGNETIC FIELD AND WITH CATHODE SPUTTERING. Abdrashitova, D. Kh.; Guseva, M. B. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 3, 347-351(1974). (In Russian).

Data obtained experimentally on the charge concentration distribution in an ion-source plasma with oscillations of the electrons in the magnetic field and with an incandescent cathode placed in the discharge volume are presented. The effect of the particular magnetic field of the cathode spiral on the structure of the plasma column is shown as well as the possible increase in charge particle concentration by introducing a negative electrode around the cathode. (SJR)

4422 TARGET-THICKNESS DEPENDENCE OF X-RAY YIELDS IN HEAVY ION-ATOM COLLISIONS. Betz, H. D.; Bell, F.; Panke, H.; Kalkoffen, G.; Welz, M.; Evers, D. (Muenchen Univ. (F. R. Germany). Sektion Physik). Phys. Lett., A; 49: No. 2, 133-134(26 Aug 1974).

In recent years, many authors have studied cross-sections for the production of projectile x-rays which result from collisions of heavy ions traversing solid targets. One has generally assumed that the yield of projectile x-rays increases proportionally to the thickness of the target, provided that (i) the fraction of beam ions with vacancies which give rise to the observed x-rays remains small, and (ii) effects of energy loss by projectiles and absorption of x-rays in the target are corrected for. This letter demonstrates that an additional effect can occur which leads to nonproportionality between projectile x-ray yields and target thickness. Results are presented for 25 to 110 MeV sulphur in C, Al, Cu, and Ge. (auth)

4423 CYCLOTRON RADIATION FROM A LOW VOLTAGE ELECTRON BEAM. Michaelis, M.; Rumsby, P. T. (Oxford Univ. (UK). Dept. of Engineering Science). Phys. Lett., A; 49: No. 2, 125-126(26 Aug 1974).

In an attempt to produce oscillations in the submillimetre microwave region various electron beam devices have been constructed which rely on emission at the cyclotron frequency: electron cyclotron backward wave oscillator, cyclotron resonance oscillator and smooth anode magnetron. Observation of cyclotron frequency emission from a low voltage electron beam produced by a variable geometry magnetron injection gun (MIG) is reported. (auth)

4424 X–RAY CONTINUUM FROM THICK ELEMENTAL TARGETS FOR 10–50–keV ELECTRONS. Rao–Sahib, T.S.; Wittry, D.B. (Departments of Materials Science and Electrical Engineering, University of Southern California, Los Angeles, California 90007). J. Appl. Phys. 45: No. 11, 5060-5068 (Nov 1974).

The x–ray continuum from thick elemental targets was investigated from 1–10 A using a crystal spectrometer and electron energies of 10–50 keV in an electron probe microanalyzer. Experimental results corrected for absorption, atomic number, and stray radiation agreed well with theoretical calculations based on Sommerfeld's cross section and Bethe's retardation law. The calculations used an improved version of the empirical formula of Kirkpatrick and Wiedmann for the cross section. Theory and experiment agreed best for $J=11.5Z$ in Bethe's law, but taking account of known inaccuracies in the Sommerfeld cross section, the Berger–Seltzer values are recommended. Results did not verify the linear atomic number dependence of the Kulenkampff–Kramers equation; for fixed electron energy E_0 and photon energy E_ν the intensity varied as Z^n, where n ranged from 1.18 to 1.38 depending on Z, E_0, and E_ν. For fixed Z and E_ν the intensity varied approximately as (E_0-E_ν). Agreement of theory and experiment indicated that the correction procedures commonly used for characteristic lines can be applied to the continuum but the atomic number correction using Duncumb and Reed's procedure differed for the continuum compared to that for characteristic lines. Absorption correction using $f(\chi)$ of Andersen and Wittry gave good results for $f(\chi) \geq 0.4$ but lower values could not be conclusively tested because of errors due to stray radiation which is shown to be caused by electrons backscattered from the specimen. Nevertheless, it was possible to use the Z dependence of the continuum to estimate certain mass absorption coefficients. (auth)

4425 POLARIZATION AND COLLISION–INDUCED COHERENCE IN THE BEAM–FOIL LIGHT SOURCE. Liu, C.H.; Bashkin, S. (Department of Physics, University of Arizona, Tucson, Arizona 85721); Church, D.A. Phys. Rev. Lett. 33: No. 17, 993-995 (21 Oct 1974).

Polarization up to 15% has been detected in the decay of electronic levels in many–electron monatomic systems which were excited by the beam–foil method, the foil being tilted with its plane at 65° to the particle velocity. Quantum beats were found even with an external magnetic field oriented parallel to the particle velocity, indicating that coherence is produced in the beam–foil interaction itself. Results are reported for various levels in He I, O II, and Ar II. (auth)

4426 K X-RAY EMISSION FROM 20- TO 36-MeV FLUORINE PROJECTILES FOLLOWING ELECTRON CAPTURE TO EXCITED STATES. Brown, M. D.; Ellsworth, L. D.; Guffey, J. A.; Chiao, T.; Pettus, E. W.; Winters, L. M.; Macdonald, J. R. (Kansas State Univ., Manhattan). Phys. Rev., A; 10: No. 4, 1255-1262 (Oct 1974).

The projectile K x-ray emission cross sections for fluorine ions were measured under single collision conditions for charge states ranging from +4 to +9 in a thin argon target. The dependence of these cross sections upon the energy and the initial charge state of the projectile was determined for fluorine ions with energies between 20 and 36 MeV. Over the entire energy range, the K x-ray-production cross section for F^{+9} ions was about 70% of the total electron-capture cross section determined in a separate experiment. The K x-ray-production cross section for these fully stripped ions is attributed to electron capture to excited states of the projectile. Calculations of electron-capture cross sections within the Brinkman-Kramers approximation for these heavy-ion collisions are consistent with the observation of large cross sections for capture to excited states. (auth)

4427 THEORETICAL LIMITATIONS OF ELECTRON BEAMS OF RECTANGULAR CROSS SECTION. Read, F. H. (Univ. of Manchester, Eng.). J. Phys., D (London); 7: No. 12, 1604-1611 (11 Aug 1974).

Two separate aspects of beams of rectangular cross section have been considered, namely the maximum space-charge-limited current which can be passed through rectangular slot apertures, and the maximum current density which can be obtained in collimated and focused beams. Both these limiting effects must be considered when attempting to maximize the current in beams of rectangular cross section. In both cases it has been found that the maximum current density is approximately the same for doubly focused rectangular beams, for singly focused ribbon beams, and for axially symmetric beams. (auth)

4428 INTERACTION OF ATOMIC PARTICLES WITH A SOLID SURFACE. I. Resonance Processes. Janev, R. K. (Observatoire de Paris, Meudon, France). J. Phys., B (London); 7: No. 12, 1506-1517(21 Aug 1974).

The problem of the interaction of an atomic particle (atom or ion) with a solid surface is considered. The electron transition probabilities of resonant ionization and neutralization processes are determined by a nonperturbative method, which provides asymptotically correct results. The transition rates as well as mean transition distances for these processes are also calculated. Parameters determining the transition probabilities are given for several atoms. (auth)

4429 PRODUCTION OF DE-EXCITED H_3^+ IONS AND MEASUREMENTS OF THE ENERGIES OF TWO ELECTRONICALLY-EXCITED STATES. Peart, B.; Dolder, K. T. (Univ. of Newcastle upon Tyne, Eng.). J. Phys., B (London); 7: No. 12, 1567-1573(21 Aug 1974).

Five different ion sources were investigated to find one which produced currents of de-excited H_3^+ ions which are adequate for crossed beam experiments. An inclined beam technique was then used to measure absolute cross sections, for energies between 15 and 22 eV, for the formation of protons by collisions between electrons and H_3^+. From the shape of the excitation function it was established that the H_3^+ ions had negligible internal energy and that they had two electronically-excited states with energies 15 and 19.2 eV above the lowest vibrational ground state. These energies are in satisfactory agreement with Kawaoka and Borkman's (J. Chem. Phys.; 54: 4234-8 (1971)) calculations of the energies of the $^3E'$ and $^1E'$ states of equilateral H_3^+. (auth)

4430 INTERACTION OF ATOMIC PARTICLES WITH A SOLID SURFACE. II. Resonant Ionization of Hydrogen-Like Atoms. Janev, R. K. (Observatoire de Paris, Meudon, France). J. Phys., B (London); 7: No. 12, L359-L361(21 Aug 1974).

The leading term in an asymptotic expansion of the resonant ionization probability in the interaction of slow hydrogen-like atoms with solid state surfaces is obtained in closed form. A procedure for calculation of the subsequent terms is also outlined. (auth)

4431 SPECTRAL DISTRIBUTION OF MULTIPLE COMPTON SCATTERING FOR X-RAYS. Williams, B. G.; Pattison, P.; Cooper, M. J. (Warwick Univ., Coventry, Eng.). Phil Mag.; 30: No. 2, 307-317(Aug 1974).

The problem of calculating analytical expressions for the spectral distribution of multiple X-ray scattering is considered. Previous results for scattering from stationary electrons are extended to include scattering in which one collision is elastic and one inelastic is also derived. The limitations of such an analytical approach are discussed with a view of indicating the probable direction of future work. (auth)

4432 COMPUTER-CONTROLLED LIGHT ION BACK-SCATTERING MEASUREMENTS WITH THE AID OF THE CAMAC SYSTEM. Becker, H.; Kubitz, M.; Marschik, W.; Offermann, P. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)). Kerntechnik; 16: No. 8/9, 380-387(Sep 1974). (In German, English).

7 figs.; 1 tab.; 8 refs.

A computer-controlled back-scattering experiment with light ions is described. Besides the physical side of the experiment, the measuring arrangement is described and the use of the CAMAC system for controlling and monitoring the experiment is discussed in detail. A modular software system for controlling the experiment and for processing the raw data with an on-line computer is described. To conclude, the results of back-scatter measurements on a Si/SiO_2 structure are discussed. (auth)

4433 INCREASING THE INTENSITY OF A SINGLE-MASS ION BEAM IN MASS-MONOCHROMATORS BY MEANS OF A DECELERATING SYSTEM. Vinogradova, O. A.; Dimitrov, S. K.; Zhitlukhin, A. M.; Smirnov, V. M.; Tel'kovskii, V. G. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 2, 337-338(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 2, 39-40(1974).

A method is described for obtaining beams of ions having an energy below 100 eV by the method of decelerating initially accelerated particles. An electrostatic deceleration system with a potential distribution that reproduces the potential distribution of a point charge placed at the focus of a convergent ion beam is used as the deceleration device. It was established experimentally that for ion energies of 80 eV the use of the deceleration method allowed the density of the current to the target to be increased by a factor of 10^5. Under these conditions the degree of deceleration amounted to 0.98, and the system efficiency reached 55%. (auth)

Atomic and Molecular Properties

Refer also to abstracts 3091, 4234, 4429, 4430, 4534, 4544, 4557, 4562, 5103, and 5522.

4434 (LBL-3084) PRECISION g_J MEASUREMENTS ON LIGHT ATOMS: $g_J(^4He, 2^3S_1)/g_J(H, ^2S_{1/2})$. Zak, B. D.; Ayguen, E.; Shugart, H. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 14 Aug 1974. Contract W-7405-eng-48. 25p. (CONF-740711-5). Dep. NTIS $4.25.

From 4th international conference on atomic physics; Heidelberg, F. R. Germany (22 Jul 1974).

A concise review is presented of the experimental and theoretical determinations of three quantities: $g_J(H)/g_J(D)$; $g_J(H)/g_e$; and $g_J(He, 2^3S_1)/g_J(H)$. These quantities serve as tests of an understanding of the Zeeman effect in simple bound systems. Also the discrepancy between the helium-hydrogen g-factor ratio as determined using an atomic beam technique: $g_J(He, 2^3S_1)/g_J(H) = 1 - 23.25(30) \times 10^{-6}$, and that obtained by Leduc, Laloë, and Brossel using optical pumping: $g_J(He, 2^3S_1)/g_J(H) = 1 - 21.60(32) \times 10^{-6}$ is critically examined. The uncertainty quoted for this determination is that given by a recalculation presented. The result is in excellent agreement with theory as well as with a previous measurement, while that of Leduc, Laloë, and Brossel now differs from theory by five standard deviations. (auth)

4435 SPIN POLARIZATION TRANSFER REACTIONS. I. Chemiionization and Surface Electron Ejection by He(2^3S). II. A Polarized Electron Source. III. Electron Exchange Reactions with O_2 and NO. Keliher, P. J. Houston, TX; Rice Univ. (1974). 215p. University Microfilms Order No. 74-21,287.

Thesis (Ph.D.).

Several experiments are presented concerning the spin dependence of atomic reactions utilizing the techniques of optical pumping to spin polarize the 2^3S metastable state of helium. These reactions are studied in a flowing helium afterglow. The spin orientation of electrons produced in ionizing reactions of the He(2^3S) state is monitored by extracting electrons from the afterglow and performing a Mott scattering experiment from a thin gold foil at 120 keV energy and at an angle of 120°. First one investigates the dynamics of ionizing collisions (i.e., chemiionization) of He(2^3S) atoms with several foreign gas atoms and molecules. It is found that electron spin angular momentum conserved to a very high degree if not completely for reactions of He(2^3S) with Ar, H_2, N_2, CO_2, N_2O, NH_3, CH_4 and to a lesser degree for the reactions of He(2^3S) with CO. This indicates that the ejected electrons do not participate in any long lived collision complexes or intermediate states. Electrons ejected from a contaminated brass surface by He(2^3S) atoms exhibit an 80 ± 10% conservation electron spin polarization. It is concluded that most surface ejected electrons arise from chemiionization of loosely bound absorbed species rather than from the conduction band of the metal. A method of utilizing the above chemiionization reaction to produce intense beams of polarized electrons is described in detail, and the present limitation of polarization and current are discussed. Beams of 30 to 20 percent polarization at respective currents of .5 to 3×10^{-6} were realized with an energy spread less than .5 eV. Polarized electron scattering can also be performed in the flowing afterglow at thermal energies. Preliminary results for the total spin exchange cross section for e-NO scattering is $2.2 \pm .6 \times 10^{-18}$ cm^3 and for e-O_2 scattering, it is $4 \pm 1 \times 10^{-19}$ cm^2. These cross sections are calculated assuming that electron exchange with the unpolarized NO($^2\pi$) and $O_2(^3\Sigma_g)$ ground states is the dominant mechanism for reversal of the scattered electron spin. However, in the case of O_2, the additional mechanisms of spin orbit coupling during resonant scattering via the O_2^{-*} state may also contribute. (Diss. Abstr. Int., B)

4436 INTERACTION OF EXCITED AND GROUND-STATE HELIUM ATOMS: POTENTIAL ENERGY CURVES AND INELASTIC PROCESSES. Steets, W. J. Houston, TX; Rice Univ. (1974). 209p. University Microfilms Order No. 74-21,340.

Thesis (Ph.D.).

A theoretical study of some excited states of He_2 was carried out in order to better understand the mechanisms for excitation transfer and associative ionization in helium. Wave functions and potential curves for the lowest three $^3\pi_u$ states, five $^3\Sigma_u^+$ states and eight $^3\Sigma_g^+$ states were calculated using the configuration interaction method with special emphasis on states which dissociate to the n = 3 levels of atomic helium. The $3^3S \rightarrow 3^3P$ and $3^3P \rightarrow 3^3S$ excitation transfer cross sections were investigated in the Landau-Zener approximation. A mechanism for association ionization is discussed in terms of the molecular wave functions and potential curves. The potential energy curves and cross sections are compared with prior calculations and experimental results when available. (Diss. Abstr. Int., B)

4437 VIBRATIONAL SPECTRUM AND FORCE FIELD OF URANIUM HEXAFLUORIDE. McDowell, R.S.; Asprey, L.B.; Paine, R.T. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). J. Chem. Phys. 61: No. 9, 3571-3580 (1 Nov 1974).

A total of 44 bands in the infrared and Raman spectra of $^{238}UF_6$ vapor has been measured using long-path absorption cells and multiple-reflection Raman cells. The types of contours exhibited by these bands, and analogous contours in the spectrum of SF_6, are discussed. Overtone and combination bands with resolved Q branches are used to estimate the anharmonicity corrections for the stretching fundamentals. The infrared contours of ν_3 (at 238 K) and ν_4 (at 256 K) have yielded estimates for the Coriolis constants ζ_3 and ζ_4 that satisfy the sum rule. The $^{235}UF_6-^{238}UF_6$ frequency shifts in these fundamentals have also been measured. All of these data, plus vibrational amplitudes from the electron diffraction study of Seip, have been combined to determine the general quadratic harmonic force field of UF_6. Only three valence force constants are appreciably different from zero: $f_r=3.85\pm0.05$, $f_\alpha \simeq f_\alpha - f_{\alpha\alpha'} = 0.12\pm0.01$, and f_{rr} (cis interaction) $= 0.30\pm0.02$, all in mdyn/Å. The large differences between this force field and that previously determined for WF_6 are attributed to the effects of f—orbital contributions in UF_6. (auth)

4438 DISTORTED ATOMS IN MOLECULES (DAM) MODEL FOR ORDINARY COVALENT MOLECULES. II. FORCE CONSTANTS FOR H_2, LiH, AND BeH^+ AS WELL AS MEDIUM RANGE REPULSION OF $H+H(^3\Sigma_u)$ AND He+He. Kirtman, B.; Chang, S.Y.; Scott, W.R. (Department of Chemistry, University of California, Santa Barbara, California 93106). J. Chem. Phys. 61: No. 9, 3700-3706 (1 Nov 1974).

The distorted atoms in molecules valence—bond model is used to determine potential energy curves near equilibrium for H_2, LiH, and BeH^+ as well as in the medium range repulsive region for $H+H(^3\Sigma_u)$ and He+He. It is shown that the force constants that we obtain by numerical differentiation are, in principle, equal to those that would be found by double perturbation theory. The usual (single) perturbation method, however, contains a first—order error. Our values for all force constants including the anharmonic ones lie within 10% of experiment except for k_2 of BeH^+. The somewhat larger (20%) error in the latter case is probably due to omission of ionic—covalent mixing. (auth)

4439 GROUND LEVELS AND IONIZATION POTENTIALS FOR LANTHANIDE AND ACTINIDE ATOMS AND IONS. Martin, W.C.; Hagan, L.; Reader, J.; Sugar, J. (Institute for Basic Standards, Washington, D.C. 20234). J. Phys. Chem. Ref. Data 3: No. 3, 771-779 (Sept 1974).

Values of the first four ionization potentials of the lanthanides ($Z=57-71$) and of Hf have been compiled. All except the value for neutral Hf are based on spectroscopic data. The spectroscopic designations of the ground levels of the neutral through triply ionized atoms ($Z=57-72$) are also tabulated. A similar compilation for the actinides ($Z=89-103$) lists Sugar's recent values for the first ionization potentials through No ($Z=102$). Accurate spectroscopic ionization potentials have been determined for only two of the actinide ions (Ac^+ and Th^{3+}). The ground—level designations for the neutral through triply ionized actinides are given where they are known or can be predicted with near certainty. A selection of references to the most complete and most recent work on the analyses of the optical spectra of the neutral through triply ionized lanthanide and actinide elements is included. (auth)

4440 ON ANALYTIC FITS TO THE GORDON—SECREST POTENTIAL ENERGY SURFACE FOR $He-H_2$. Secrest, D. (School of Chemical Sciences, University of Illinois, Urbana, Illinois 61801). J. Chem. Phys. 61: No. 9, 3867-3868 (1 Nov 1974).

Recently Alexander and Berard [J. Chem. Phys. 60, 3950 (1974)] studied $He-H_2$ vibrational energy transfer using four new analytic fits to the Gordon—Secrest ab initio potential surface. This comment suggests that the new fits may not be as realistic as the original fit. (AIP)

4441 ON ANALYTIC FITS TO THE GORDON—SECREST POTENTIAL ENERGY SURFACE FOR $He-H_2$: A REPLY. Alexander, M.H. (Department of Chemistry, University of Maryland, College Park, Maryland 20742). J. Chem. Phys. 61: No. 9, 3868-3869 (1 Nov 1974).

This comment agrees that the original Gordon—Secrest fit [J. Chem. Phys. 52, 120 (1970)] may be more physically realistic than subsequent fits by Alexander and Berard [J. Chem. Phys. 60, 3950 (1974)], as pointed out by Secrest in the preceding comment. However, the original purpose of the later work was to illustrate the difficulties which can arise in fitting a set of ab initio points. (AIP)

4442 ELECTRONIC STRUCTURE OF UF_6^-. Boring, M.; Wood, J.H. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544); Moskowitz, J.W. J. Chem. Phys. 61: No. 9, 3800-3803 (1 Nov 1974).

The SCF—$X\alpha$—SW method is used to carry out an approximate Hartree—Fock calculation on the electronic structure on UF_6^-. The charge density within the atomic spheres is analyzed into its angular momentum components and the first two excited electronic states are computed. (auth)

4443 STARK EFFECT OF METASTABLE HYDROGEN MOLECULES. English, T.C.; Kagann, R.H. (Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado 80302). Phys. Rev. Lett. 33: No. 17, 995-998 (21 Oct 1974).

The molecular—beam magnetic—resonance method has been used to measure the Stark effect of the metastable $c^3\Pi_u$ electronic state of H_2. The magnitude of the effect is found to be about 10^4 times greater than for the ground electronic state and to depend sensitively upon vibrational quantum number. A theoretical treatment of the effect has allowed us to identify at least three vibrational states of H_2 which are metastable, including $v=0$ and 1. (auth)

4444 PHOTOELECTRIC CROSS SECTIONS OF GAMMA RAYS FOR LOW-, MEDIUM-, AND HIGH-Z ATOMS IN THE ENERGY RANGE 88 keV TO 1.33 MeV. Goswami, B.; Chaudhuri, N. (North Bengal Univ., Darjeeling, India). Nuovo Cim.; 24A: No. 1, 49-60(1 Nov 1974).

Total atomic photoelectric cross sections of gamma-rays of energy from 88 keV to 1.33 MeV for 34 elements in the range of Z from 12 to 92 were determined from the accurately measured total cross sections. Direct measurements on lead for ^{137}Cs and ^{60}Co gamma rays were also made in a cylindrically symmetric transmission arrangement to obtain total photoelectric cross sections. The experimental total cross sections and K-shell cross sections derived from the measured total cross sections were compared with those from the recent theories and measurements. The dependence of total photoabsorption on the atomic number of the absorber and the gamma-ray energy was studied. (auth)

4445 EXPERIMENTAL INVESTIGATION OF THE POLARIZABILITY OF THE H_2 MOLECULE IN THE EXCITED VIBRATIONAL STATE. Butylkin, V. S.; Venkin, G. V.; Kulyuk, L. L.; Maleev, D. I.; Protasov, V. P.; Khronopulo, Yu. G. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 19: No. 7, 253-255(5 Apr 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 7, 474-478(5 Apr 1974).

By an interference method the change produced in the dielectric constant of hydrogen by excitation of the vibrational state in SRS was observed and measured. The polarizability of the first excited vibrational state of the H_2 molecule was determined. (auth)

4446 CALCULATION OF THE MAGNETO—OPTICAL ACTIVITY OF THE HYDROGEN MOLECULE. Svendsen, E. N.; Hameka, H. F. (Univ. of Pennsylvania, Philadelphia). Int. J. Quant. Chem.; 8: No. 5, 789-797(Sep 1974).

The Verdet constant of the hydrogen molecule was calculated. It was found that the angle of rotation may be represented by $\phi_0 = A_0H\nu^2/(\nu_0^2 - \nu^2)^2$ where A_0 is 3.23×10^{-33} microminutes sec^2 per oersted-cm-atmosphere. This is in agreement with the experimental observations where ϕ_0 is given by the same frequency dependence with the constant $A_0 = 2.72\times 10^{-33}$ in terms of the same units. (auth)

4447 HIGHER RYDBERG STATES OF He USING THE POLARIZED-ORBITAL METHOD. Temkin, A.; Silver, A. (Goddard Space Flight Center, Greenbelt, MD). Phys. Rev., A; 10: No. 4, 1439-1441(Oct 1974).

Rydberg states of He of the configuration $(1s\ nl)^{1,3}D$, $^{1,3}F$ for $n = 3$ to 7 were calculated using polarized-orbital and related approximations, notably the extended-polarization approximation. The singlet states are superior in the full polarized-orbital approximation whereas the triplet cases are better in the extended-polarization approximation. Reasons for this behavior are given. Comparison is also made with recent diagrammatic calculations of Chang and Poe. A comment on some recent polarized-orbital calculations of photoionization is included. (auth)

4448 FROZEN-CORE APPROXIMATION FOR DIATOMIC MOLECULES. II. The $b\,^3\Sigma_u^+$, $a\,^3\Sigma_g^+$, and E,F $^1\Sigma_g^+$ States of H_2. Jackson, M.; McEachran, R. P. (York Univ., Toronto). J. Phys., B (London); 7: No. 13, 1782-1789(11 Sep 1974).

Minimum configuration MO wavefunctions appropriate for small internuclear separations, $R \leq 4.0$ au, are employed within the context of a frozen-core approximation to calculate total electronic energies for the $b\,^3\Sigma_u^+$, $a\,^3\Sigma_g^+$, and E,F $^1\Sigma_g^+$ states of H_2. The results are in good agreement with refined variational calculations over this range. Transition moments and oscillator strengths for the E,F → B and a → b electronic transitions have also been computed. Those for the E,F → B transition are in fair agreement with those of Wolniewicz (J. Chem. Phys.; 51: 5002-8 (1969)), suggesting that the present results for the a → b transition (which have not been calculated previously) will be of comparable accuracy. (auth)

4449 BROADENING OF He I LINES INCLUDING ION DYNAMIC CORRECTIONS, WITH APPLICATION TO λ 4471A. Barnard, A. J.; Cooper, J.; Smith, E. W. (Univ. of British Columbia, Vancouver). J. Quant. Spectrosc. Radiative Transfer; 14: No. 10, 1025-1077(Oct 1974).

A theory is developed for the broadening of He I lines with forbidden components which is valid at low densities (where the forbidden line is reasonably well isolated). This theory takes into account the effects of dynamic ion broadening. Application to λ 4471Å gives good agreement with experiment and with a recent calculation of Lee (J. Phys.; B5: L 23 (1972), and B 6: 1044 (1973)); reasons for agreement with Lee are discussed in detail. Comprehensive tables for 4471Å are presented. These have been extended further into the line wings than previous tabulations. Static ion theory is found to be adequate for densities greater than $\sim 5 \times 10^{15}$ cm^{-3}. A simple numerical profile for allowed lines, taking into account dynamic ion effects, is also presented. (auth)

4450 LIGHT IONS OF ASTROPHYSICAL INTEREST. Radiative Transition Probabilities for C III, N IV, O V, and Ne VIII. Hummer, D. G.; Norcross, D. W. (National Bureau of Standards, Boulder, CO). Mon. Notic. Roy. Astron. Soc.; 168: No. 2, 263-272(Aug 1974).

Multiconfiguration calculations of energy levels and bound-bound radiative transition probabilities for four astrophysically important ions of the Be isoelectronic sequence are presented. Convergence of the results with respect to the number of configurations included in the expansion is discussed. Results are presented for all ions from models with 11 and 16 configurations; including transition probabilities for 24 allowed electric dipole transitions. Some significant differences from previous calculations are obtained. The theoretical lifetimes are generally in good accord with those obtained by the beam-foil technique, and the results of other ab initio calculations. (auth)

4451 EXCITED DOUBLY CHARGED IONS FORMED IN THERMAL ENERGY COLLISIONS. Littlewood, I. M.; Webb, C. E. (Oxford Univ.). J. Phys., B (London); 7: No. 11, L332-L334(1 Aug 1974).

The resonance lines of the third spectrum of each of yttrium and lanthanum have been observed in the emission from a cold helium afterglow plasma when a small concentration of the element is introduced. The excitation is attributed to formation of the ions in the upper levels directly, as a result of hybrid charge-transfer/Penning reactions with He^+ ions. (auth)

4452 ORTHOGONALITY CONDITIONS TO LOWER-LYING STATES AND CONVERGENCE OF THE HYLLERAAS–UNDHEIM–PEKERIS METHODS. Edrmolaev, A. M. (Queen's Univ., Belfast). J. Phys., B (London); 7: No. 13, 1611-1619(11 Sep 1974).

It has been demonstrated that slow convergence of the Hylleraas–Undheim–Pekeris methods (Hylleraas and Undheim. Z. Phys.; 65: 759-72 (1930). Pekeris. Phys. Rev.; 127: 509-11 (1962)) for low-lying states of two-electron atoms is due to the need for the wavefunctions of these states to satisfy additional orthogonality conditions. A new expansion is proposed, which leads to a remarkable improvement of convergence of the variational ionization energies of the excited singlet S-states of He and Li^+. (auth)

4453 STARK PROFILE FOR THE 304 A RESONANCE LINE OF IONIZED HELIUM. Goto, T.; Burgess, D. D. (Imperial Coll. of Science and Tech., London). J. Phys., B (London); 7: No. 13, L377-L380(11 Sep 1974).

Stark profiles of the He II resonance line have been measured photoelectrically for several conditions in the range $5 \times 10^{16} \leq n_e \leq 2 \times 10^{17}$ cm^{-3} and $3.2 < T_e < 3.5$ eV, using a Z-pinch as a plasma source. If the spatial electron density distribution is taken into account, the measured line profiles are in reasonable agreement with theoretical profiles calculated by Kepple (Phys. Rev.; A6: 1-9 (1972)). (auth)

4454 1/Z-EXPANSION ANALYSIS OF SINGLET–TRIPLET DIFFERENCES IN THE LOWEST $^{1,3}\Pi$ STATES OF H_2, HeH^+, AND LiH^{++}. Colbourn, E. A.; Coulsen, C. A. (Oxford Univ.). J. Phys., B (London); 7: No. 12, 1574-1581(21 Aug 1974).

Energy differences, and differences in kinetic energies, nuclear attraction energies and interelectronic repulsion energies are given for the lowest $^{1,3}\Pi$ states of H_2, HeH^+, and LiH^{++}, and an analysis of the results in terms of 1/Z expansions is presented. If Z is used to denote the charge of the nucleus of higher atomic number, then it is found that at low Z the difference in interelectronic repulsion is dominated by higher-order terms, and that the often-quoted statement that the singlet–triplet energy difference is twice an exchange integral is true only for high values of the nuclear charge Z. (auth)

4455 NUMERICAL POTENTIAL OF DIATOMIC MOLECULES: QUANTUM METHOD. Kobeisse, H. (Lebanese Univ., Hadeth); Hajj, F. Y. J. Phys., B (London); 7: No. 12, 1582-1587(21 Aug 1974).

A method has been derived to find the potential of diatomic molecules from the given experimental eigenvalues and rotational constants. The potential is found by computing the coordinates of the turning points. The method is different from the semiclassical R K R method and is based on simple and straightforward quantum mechanical principles. The present method is applied to the $B^1 \Sigma_u^+$ of the H_2 molecule. The results are compared with other results of the same state and show a marked improvement. (auth)

4456 LIFETIME MEASUREMENT OF THE 2^3P STATE OF HELIUM. Thompson, R. T. (Univ. of Oklahoma, Norman). J. Quant. Spectrosc. Radiative Transfer; 14: No. 11, 1179-1183(Nov 1974).

The lifetime of the 2^3P state of He has been determined experimentally to be 125 ± 7 nsec. The measurement was made using delayed coincidence with an invertron as the excitation chamber. A simple tunnel-diode preamplifier was designed to extend the usefulness of single photon counting photomultipliers into the infrared. (auth)

4457 LONG-RANGE INTERACTIONS OF EXCITED HYDROGEN ATOMS. Stephens, T. L. (Harvard Coll. Observatory, Cambridge, MA); Dalgarno, A. Mol. Phys.; 28: No. 4, 1049-1059(Oct 1974).

Accurate calculations are reported of the first- and second-order long-range interactions of a hydrogen atom in its ground state and a hydrogen atom in the excited 2s, 2p, 3s, 3p and 3d states. The connections with the spectroscopic states of molecular hydrogen are established. First-order mixing occurs for the $n = 3$ states and the form of the long-range interaction is complicated. (auth)

4458 NUCLEAR MOTION CORRECTIONS TO SOME ELECTRIC AND MAGNETIC PROPERTIES OF DIATOMIC MOLECULES. Buckingham, A. D.; Cordle, J. E. (Cambridge Univ., Eng.). Mol. Phys.; 28: No. 4, 1037-1047(Oct 1974).

It is commonly assumed that the nuclei are at a fixed separation when relating the electric quadrupole moment of a diatomic molecule in a $^{11}\Sigma$ state to the rotational g value and the magnetizability anisotropy. This assumption is examined with particular reference to the hydrogen isotopes and is found to lead to an error of approximately 1 per cent in the quadrupole moment. The paramagnetic magnetizability and rotational g value function for hydrogen are extracted from published experimental data, and combination of the latter with an accurate calculation of the quadrupole moment leads to precise values of the magnetizability anisotropy for the lower vibration–rotation states of hydrogen. An experimental measurement of the rotational g value for just one further state or isotope of hydrogen is required to make the analysis more accurate. (auth)

4459 L_2 SUBSHELL COSTER–KRONIG YIELDS AT HIGH Z. Veluri, V. R.; Wood, R. E.; Palms, J. M.; Rao, P. V. (Emory Univ., Atlanta). J. Phys., B (London); 7: No. 12, 1486-1493(21 Aug 1974).

The transition probabilities for $L_2 - L_3X$ Coster–Kronig transitions at Z = 63, 65, 73, 80 and 81 are measured by observing the ratio of K_{α_1} and K_{α_2} x rays in coincidence with L_α x rays during the radioactive decays of ^{151}Gd, ^{159}Dy, ^{181}W, ^{198}Au and ^{204}Tl, and ^{203}Hg, respectively, by employing Si(Li) detectors. A comparison of the experimental results with the existing theoretical predictions indicates that there is general agreement with the recent calculations by Chen and Crasemann (Inner Shell Ionization Phenomenon and Future Applications. US Atomic Energy Commission (1973)). (auth)

4460 UNSTABLE IONIZATION WAVES IN HELIUM. Jackson, A. T. (Belfast Coll. of Tech.). J. Phys., D (London); 7: No. 12, 1699-1702(11 Aug 1974).

A discussion is given of some dispersion curves of ionization waves in the helium positive column. (auth)

4461 HIGHLY EXCITED ATOMS. Percival, I. C. (Univ. of Sterling, Scotland). pp 65-83 of Atoms and Molecules in Astrophysics. Carson, T. R. (ed.). New York; Academic Press, Inc. (1972).

From 12th session of Scottish universities summer school in physics atoms and molecules in astrophysics; Stirling, UK (Aug 1971). See CONF-710859-.

The properties of the hydrogen atoms are considered as a test case in order to study the properties of highly excited atoms required for a detailed understanding of recombination and ionization balance in stellar atmospheres. The properties involved in the interstellar radio recombination lines are considered. (JFP)

4462 SPECTRAL INTENSITIES FROM HELIUM-LIKE IONS. Gabriel, A. H. (Culham Lab., Eng.). pp 311-320 of Atoms and Molecules in Astrophysics. Carson, T. R. (ed.). New York; Academic Press, Inc. (1972).

From 12th session of Scottish universities summer school in physics atoms and molecules in astrophysics; Stirling, UK (Aug 1971). See CONF-710859-.

A discussion is given of measurements of electron temperature and density. The particular advantages of helium-like ions for density measurement are considered. Reference is made to some solar properties. (JFP)

4463 SOME COMMENTS ON OPEN SHELL HARTREE–FOCK METHODS FOR MOLECULES: THE HYDROGEN MOLECULE ANION. Davies, D. W.; del Conde, G. (Univ. of Birmingham, Eng.). Rev. Mex. Fis.; 22: No. 4, 343-348(1973).

Expressions for the one and two Fock operators for the H_2^- molecule are derived in Hartree-Fock methods for open shell molecules. Furthermore the values of the Lagrange multipliers for H_2^- are shown, and also the molecular orbital coefficients, by using two different sets of gaussians as basis functions. (auth)

4464 CALCULATION OF ATOMIC CHARGES BY AN ELECTRONEGATIVITY EQUALIZATION PROCEDURE. Jolly, W. L.; Perry, W. B. (Univ. of California, Berkeley). Inorg. Chem.; 13: No. 11, 2686-2692(Nov 1974).

A procedure for calculating atomic charges based on the equalization of atomic orbital electronegativities was extended to cover compounds containing any of the elements in the periodic table up to radon. Atomic charges calculated by this method correlate well with core electron binding energies using the potential equation. The correlations are generally improved by inclusion of a relaxation energy term, calculated on the basis of the principle of equivalent cores. (auth)

4465 EXPANSION OF GAUSSIAN FUNCTIONS IN HYDROGEN EIGENFUNCTIONS. Dose, V. (Univ., Zurich); Semini, C. Helv. Phys. Acta; 47: No. 3, 307-320(1974).

Methods were developed which allow the expansion of Gaussian functions $r^j\ Y_l^m(\vartheta,\varphi) \cdot \exp(-\alpha r^2)$ in discrete and continuous eigenfunctions of the hydrogen atom. Different approaches are presented for application in different regions of an $\alpha - k$ and $\alpha - n$ plane respectively where k is the electron momentum in a continuous state and n is the principal quantum number of a discrete state. Detailed numerical results were obtained for the special case $l = j = 0$ and exponent parameters α in the range $10^{-5} \leq \alpha \leq 10^2$. An overall check of the accuracy of the results is possible with the help of the closure relation which is in all cases satisfied to better than 10^{-5}, demonstrating the satisfactory reliability of the proposed methods. (auth)

4466 SPATIAL ANISOTROPY OF SPONTANEOUS RADIATION FROM FIXED ATOMS IN A STRONG FIELD. Golubev, Yu. M. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz.; 66: No. 6, 2028-2036(Jun 1974). (In Russian).

It is shown that the spontaneous radiation beat spectrum for atoms in a strong field possesses spatial anisotropy. This phenomenon is closely related to the combinational coupling effect which should be taken into account in the presence of a strong field. (auth)

4467 INCOHERENT PHOTON SCATTERING BY HYDROGEN FORBIDDEN IN THE DIPOLE APPROXIMATION. Gorshkov, V. G.; Mikhailov, A. I.; Sherman, S. G. (Leningrad Inst. of Nuclear Physics). Zh. Eksp. Teor. Fiz.; 66: No. 6, 2020-2027(Jun 1974). (In Russian).

Formulas are obtained for the cross section for photon scattering by hydrogen involving transition of the electron from the 1s to 2p state. This transition is forbidden in the dipole approximation. The formulas are valid for the whole nonrelativistic photon energy region in which $\omega \ll m$, where m is the electron mass. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 3605, 4555, and 4595.

4468 EXPERIMENTAL STUDIES OF MUONIUM PRODUCTION AND THE MUONIUM–ANTIMUONIUM TRANSITION IN FREE SPACE. Hsieh, C. S. Williamsburg, VA; Coll. of William and Mary (1974). 140p. University Microfilms Order No. 74-22,285.

Thesis (Ph.D.).

Experimental studies of muonium production and a search for the muonium (μ^+e^-) to antimuonium (μ^-e^+) transition in a vacuum space are reported. The emission of muonium from the surface of thin gold foils was studied by a spin precession technique using the low momentum muon beam from the SREL synchrocyclotron. The data analysis of the decay asymmetry of the muons, which stopped in the gold foils, yields a lower limit for the rate of muonium formation of 0.35 ± 0.06. A search for the $(\mu^+e^-) \rightarrow (\mu^-e^+)$ process in a vacuum was carried out using (μ^+e^-) atoms formed in a thin gold foil. Observations of the possible $(\mu^+e^-) \rightarrow (\mu^-e^+)$ transition in free space is important as a test of lepton number conservation laws, and as a search for a heretofore undetected weak process. The experimental technique involved the detection of a high energy e^- from μ^- decay which occurred within a 4 μsec gate opened by the stopped μ^+ signal. The observed transition rate was consistent with zero, and the results set an upper limit on the coupling constant ratio $C_{M\overline{M}}/C_V \leq 100$, assuming the $M - \overline{M}$ process is a 4-fermion weak interaction of the universal V–A form. (Diss. Abstr. Int., B)

4469 STUDY OF THE PROPERTIES OF ATOMIC NUCLEI WITH THE AID OF MUONIC ATOMS. Engfer, R.; Walter, H. K.; Schneuwly, H. (Technical College, Zurich). Sov. J. Part. Nucl. 5: No. 2, 152-167 (Oct 1974).

Experimental investigations of muonic atoms are used to study the following problems in the physics of atomic nuclei: charge distribution; muonic isomer shift, polarizability of the nucleus by the muon, and the influence of the spatial distribution of the magnetization on the hyperfine splitting of the x–ray emission of the muon and on the nuclear gamma radiation (the Bohr–Weisskopf effect). The hyperfine electric quadrupole splitting of muonic x–ray emission and the possibility of an independent determination, with the aid of a precise model, of the quadrupole moment of the ground state of the nucleus are discussed. Comparison with other methods is used to examine the universality of the electron–nucleon and muon–nucleon interactions, to check on quantum electrodynamics, and to consider the "calibration" of the Mössbauer isomer shift and of the quadrupole splitting in pionic atoms. (auth)

4470 ENERGY LEVELS OF HIGHLY EXCITED MUONIC ATOMS. Griffith, J.E.; Haff, P.K.; Tombrello, T.A. (Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, California 91109). Ann. Phys. (N.Y.) 87: No. 1, 1-16 (Sept 1974).

Energy levels of muonic atom states with high principal quantum number are examined. A Thomas–Fermi type treatment is used in all but the lightest atoms to take account of the effects of electron shielding. Transition energies of the muon are compared to electron binding energies, and implications for muon lifetimes are discussed. The splitting of angular momentum substrates is explicitly studied; transitions with no change in principal quantum number are unlikely to be important. Effective charges for the muon are computed. The possibility of an absorptive component of the muon potential is raised. (auth)

4471 EFFECTIVE PRODUCTION OF POSITRONIUM IN A DIELECTRIC-METAL SYSTEM. Gol'danskii, V. I.; Levin, B. M.; Shantarovich, V. P.; Agievskii, D. A.; Landau, M. V. (Inst. of Chemical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 7, 241-243(5 Apr 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 7, 448-451(5 Apr 1974).

Using high porosity dielectrics (zeolites) with metallic inclusions as an example, one could observe experimentally, for the first time, in metal-containing systems, the long-lived component of the temporal spectrum of positron annihilation, corresponding to positronium production. (auth)

4472 EFFECT OF DOPING ON POSITRON LIFETIME IN Si CRYSTALS. Sen, P.; Sen, C. (Nuclear Accelerator Lab., Albany, NY). J. Phys., C (London); 7: No. 16, 2776-2780(21 Aug 1974).

Positron lifetime distribution measurements in Si crystals (using both float-zoned and Czochralski crystals), intrinsic and with different dopings, have been made using ~0.290 ns (FWHM) prompt time resolution with ~37 ps slope and 40,000 : 1 peak-to-background ratio. The general trend of the time spectra essentially consists of a single exponential component τ_1 (0.223 to 0.245 ns). Because of the extra care taken in the source sample preparation the intensity, I_2, of the long component (~1 ns) was kept <0.2% in all the cases investigated and was assigned to source sample effects. Although no difference in lifetime was observed between various kinds of doped crystals, the lifetime values in the intrinsic Si crystals were found to be consistently lower than in the doped ones by ~6 to 9%, the experimental error being ~2%. This effect has been detected, possibly for the first time. (auth)

4473 GROUND STATE OF POSITRONIUM HYDRIDE. Page, B. A. P.; Fraser, P. A. (Univ. of Western Ontario, London). J. Phys., B (London); 7: No. 13, L389-L392(11 Sep 1974).

The ground state of positronium hydride has been found to be stable against dissociation into positronium and hydrogen by at least 0.0736 Ryd (1.00 eV) through a variational calculation. This dissociation energy is 26% larger than the most recently reported value. The two-photon annihilation rate is calculated to be 2.33 ns^{-1}. (auth)

4474 TEMPERATURE DEPENDENCE OF POSITRON VACANCY TRAPPING. Bergersen, B. (Univ. of British Columbia, Vancouver); Taylor, D. W. Can. J. Phys.; 52: No. 17, 1594-1602(1 Sep 1974).

A critical discussion is given of the several conflicting models that have been proposed for the temperature dependence of positron trapping by vacancies in metals. It is found that models utilizing the concept of a velocity independent trapping radius do not give a consistent description. If the trapping potential is not too strong the model most appropriate to the problem is one proposed by Hodges in which plane wave perturbation theory and the golden rule is used. When particle-hole pairs take up the excess energy and when the trap is deep compared to $\kappa_B T$ this gives a trapping rate per unit vacancy concentration which is essentially independent of temperature. The condition on the strength of the potential is found to be well satisfied assuming a hydrogenic wave function for the trapped state with a Bohr radius determined from the energy of the state. Even if the trapping potential should be too strong for the golden rule to be completely valid no important temperature dependence of the trapping rate is expected. (auth)

4475 MEASURING METHODS FOR EXOTIC NUCLEI. Recent Results. Thibault, C. (CNRS, Orsay, France). Phys. (Paris), Colloq.; No. 4, 13-21(1973). (In French).

From Centanary Congress of the French Physical Society; Vittel, France (28 May 1973).

Different measurements on exotic nuclei $T_z \geq 2$ and $Z \leq 20$, produced by compound nuclear reactions, transfer reactions, heavy ion induced reactions, or fragmentation, are reviewed. In the case of the nuclei with $T_z = 5/2$ and of the sodium isotopes with $T_z \leq 5$, the recent experimental data on masses are compared with the calculations. Even though they show a too strong odd-even effect, the Garvey-Kelson relations give the best agreement. (auth)

Collision Phenomena

Refer also to abstracts 3112, 4232, 4235, 4420, 4435, and 4436.

4476 (AD-779887) MULTIPHOTON DETACHMENT OF NEGATIVE IONS. Kroll, N. M.; Watson, K. M. (Stanford Research Inst., Menlo Park, Calif. (USA)). Mar 1974. Contract DAHC15-73-C-0370. 33p. (SRI-JSR-73-6). NTIS $3.25.

A theory is presented to describe multiphoton detachment of negative ions by intense laser beams. The detachment rate is expressed in terms of the single-photon detachment rate. Numerical results are presented for detachment of electrons from 0(-) and 02(-). Critical comments are given concerning some theories of multiphoton ionization. (auth)

4477 (AD-780456) INELASTIC COLLISIONS OF EXCITED ATOMS. Annual Report. Peterson, J. R. (Stanford Research Inst., Menlo Park, Calif. (USA)). 19 Jun 1974. Contract N00014-70-C-0339. 20p. (SRI-MP-74-22). NTIS $3.00.

The research effort is concerned with interactions of metastable electronically excited atoms with ground state atoms and molecules. Principal attention recently has been devoted to the study of ionization processes in the collisions of He(*) (2 doublet S) with ground state He: the reaction He(*) + He to He(+) + He + E(–). Experimental measurements were made using metastable atom differential scattering apparatus. The experiment represents the first successful measurement of the collisional ionization of metastable atoms at these low energies, and is the first detailed analysis of the product ion energies and angles that has been made at any energy. Three separate ionization processes were clearly identified, and at least one more appears to be present in the data. It was possible to interpret all these processes in terms of specific interactions between molecular states in the collision complex. (auth)

4478 (AD-780547) VIBRATIONAL DEACTIVATION OF $H_2(V = 1)$ BY H ATOMS. Wilkins, R. L. (Aerospace Corp., El Segundo, Calif. (USA)). 29 Mar 1974. Contract F04701-73-C-0074. 26p. (SAMSO-TR-74-108). NTIS $3.25.

Rate constants are calculated for the vibrational relaxation of H2 (V = 1) by H-atoms. A classical three-dimensional trajectory calculation is carried out to determine if both reactive and nonreactive collisions play an important role in the dynamics of this reaction on a London-Eyring-Polanyi-Sato (LEPS) potential energy hypersurface. The results of this calculation are compared with available experimental data. (auth)

4479 (AD-781981) THEORETICAL STUDIES ON N_2 AND N_2^+. Final Report, 15 August 1972–30 June 1973. Cartwright, D. C.; Fiamengo, N. A. (Aerospace Corp., El Segundo, Calif. (USA)). 25 May 1974. Contract F04701-73-C-0074. 81p. (SAMSO-TR-74-144). NTIS $4.00.

The goals of this theoretical research are: to determine a more accurate and consistent theoretical model of the excitation, emission, and deactivation properties of the N2 (+) molecular band systems excited by electrons; determine a consistent set of electron impact excitation cross sections for the electronic states of N2 over the range of incident electron energies that is relevant to understanding and predicting atmospheric processes; with these excitation cross sections, perform the theoretical studies necessary to obtain a better understanding of the excitation, emission, and deactivation properties of the various N2 band systems excited in the normal and disturbed atmosphere. The following are discussed: the meinel band system of N2 (+); theoretical work leading to study of autoionization; electron-impact excitation of electronic states of N2; and, quadrupole moment and electric field gradient of N2 (x singlet sigma (g) (+)). (auth)

4480 (AD-782487) THEORETICAL AND EXPERIMENTAL (ELECTRON IMPACT) STUDIES OF LOW-LYING RYDBERG STATES IN O_2. Cartwright, D. C.; Hunt, W. J.; Williams, W.; Trajmar, S.; Goddard, W. A. III. (Aerospace Corp., El Segundo, Calif. (USA)). 15 May 1974. Contract F04701-73-C-0074. 54p. (SAMSO-TR-74-147). NTIS $3.75.

Theoretical studies of the N = 3, 4, and 5 rydberg series in O2, converging to O2 (+) (x doublet PI(G)), are presented and correlated with electron energy loss spectra of molecular oxygen. In the region from 7.0 to 10.5 eV the angular dependence determined for various features in the energy loss spectra were correlated with the known behavior for transitions between electronic states of certain symmetry, and with the theoretical results, to identify the low lying rydberg states. Four vibrational levels of the (3 S sigma(G)) triplet PI(G) rydberg state were observed superposed on top of the maximum intensity portion of the schumann-runge continuum. The theoretical results, combined with the energy loss measurements and the high resolution photon absorption work, lead to the assignment of the lowest dipole-allowed rydberg states. (auth)

4481 (CONF-740666-2) EFFECTS OF INTERNAL ENERGY ON ION-MOLECULE REACTIONS. Chupka, W. A. (Argonne National Lab., Ill. (USA)). 1974. 14p. Dep. NTIS $4.00.

From ion-molecular reactions conference; Biarritz, France (24 June 1974).

The discussion of the effects of internal energy on ion-molecule reactions covers experimental methods, the general effects of internal energy, and rotational and vibrational energy. (JFP)

4482 (CONF-740715-17) IONIZATION BY INTERPENETRATION OF ELECTRON SHELLS. Smith, F. T.; Salop, A. (Stanford Research Inst., Menlo Park, Calif. (USA)). 1974. 32p. Dep. NTIS $4.75.

From 5th international radiation research congress meeting; Seattle, Washington, USA (14 Jul 1974).

Until recently, the prevailing model for ionization by charged particle impact was based on the Coulomb interaction of a fast structureless charged particle with the electron cloud of the target. This model is characterized by a very rapid decline in the ionization cross section at low relative velocities (measured by comparison with the electron velocity in the atomic shell being ionized). When higher Z particles with filled electron shells are used, measured cross sections for ionization are often much larger than Coulomb cross sections. This is predominantly attributable to the Pauli exclusion interaction between electrons in interpenetrating shells, which causes high promotion and even ionization of one or more of the electrons involved. This ionization process can be predicted from the behavior of quasi-molecular wave functions for the pair of colliding atoms. The same principles generally apply whether the ionization is from deep inner shells of heavy particles or from outer shells, provided the relative velocity is similar. Typical cross sections may be as large as the electron shells involved and may remain high down to threshold energies determined by the appropriate ionization potential, augmented by the effective internuclear Coulomb repulsion energy at the distance involved. (auth)

4483 (COO-1721-81) OBSERVED SINGLE ATOM ELASTIC CROSS SECTIONS IN A SCANNING ELECTRON MICROSCOPE. Retsky, M. (Chicago Univ., Ill. (USA). Dept. of Physics). 1974. 31p. Dep. NTIS $4.75.

Single atom elastic cross sections were measured in a scanning electron microscope capable of resolving single atoms of $Z \geq 47$. These measurements were made on uranium, mercury, and silver at 50 kv. The measurements are in agreement with the best available calculations. The major distinction between conventional measurements (using thin foils or gases) and the microscope measurement is the beam intensity. With uranium, for example, during each measurement each uranium atom experiences 4×10^5 elastic events and 9×10^4 inelastic events. One was able to experimentally distinguish single silver atoms from mercury or uranium, but not mercury atoms from uranium. This is attributable to the 30% experimental standard deviation of the data. The sources of the standard deviation are discussed. (auth)

4484 (COO-2130-133) IMPACT PARAMETER DEPENDENCE OF ARGON K-SHELL IONIZATION IN COLLISION WITH FAST FLUORINE PROJECTILES. Cocke, C. L.; Randall, R.; Bednar, J. A.; Curnutte, B. (Kansas State Univ., Manhattan (USA)). 1974. 3p. (CONF-740711-4). Dep. NTIS $4.00.

From 4th international conference on atomic physics; Heidelberg, F. R. Germany (22 Jul 1974).

In an attempt to probe the collision mechanism in more detail, the impact parameter dependence was measured for the pionization of the argon K-shell for two differential fluorine charge states. The resulting curve confirms the dramatic increase in x-ray production probability as one goes from F 5^+ to a bare fluorine nuclear projectile. The total cross section and impact parameter dependence are also discussed. (JFP)

4485 (COO-2130-146) ATOMIC AND NUCLEAR RESEARCH WITH ACCELERATORS. Interim Progress Report, 1 October 1973–1 October 1974. Legg, J. C. (Kansas State Univ., Manhattan (USA). Dept. of Physics). Oct 1974. Contract AT(11-1)-2130. 41p. Dep. NTIS $5.25.

Research on collisions and nuclear reactions is summarized. A list of publications is included. (JFP)

4486 (COO-3235-45) NEW METHOD IN THE THEORY OF MANY-BODY SCATTERING. Kouri, D. J.; Levin, F. S. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F. R. Germany); Brown Univ., Providence, R. I. (USA). Dept. of Physics). 1974. 14p. (CONF-740822-4). Dep. NTIS $4.00.

From conference on few body problems in nuclear and particle physics; Quebec, Canada (27 Aug 1974).

Recently new sets of coupled equations were derived for the T operators and for the K operators describing many-body scattering. The key to the method is the channel coupling array W, whose seemingly arbitrary elements are fixed by requiring the iterated kernel of the coupled equations to be connected. Unitary approximations may be introduced with relative ease, since the T and K operators are related by a damping equation and matrix elements of the K operators are real. In addition, the equations are free of spurious solutions and have the correct unitarity structure. A derivation is given of the equations; a discussion of the properties of the arrays W and of how their elements may be chosen so as to ensure connected iterated kernels; some aspects of the solutions in the N-channel case, including the formulation of a direct channel optical potential operator; connections with other formulations; and numerical applications, particularly to $e^- + H$ scattering. (auth)

4487 (LBL-2980) ELECTRONIC STRUCTURE QUANTUM MECHANICS APPLIED TO SOME SMALL POLYATOMIC MOLECULES. Liskow, D. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1974. Contract W-7405-eng-48. 95p. Dep. NTIS $7.75.

Thesis.

Quantum mechanics is used to compute ab-initio wave functions for several molecular systems in order to derive theoretical estimates for their structure and chemical behavior. The structure of the HO_2 radical is investigated with SCF and CI wave functions and is predicted to have a 106.8° bond angle. The bending potential energy for C_3, a species in carbon vapor, is investigated with SCF and CI wave functions, and the results support the unusually low bending vibrational frequency previously determined experimentally. An SCF wave function is used to determine features of the $CH_3NC \rightarrow CH_3CN$ isomerization potential energy surface. And lastly, features of the $C^+ + H_2 \rightarrow CH^+ + H$ reaction potential energy surfaces are determined with CI wave functions. (auth)

4488 (LBL-3143) SEMICLASSICAL METHODS AND THEIR APPLICATION TO PROBLEMS IN COLLISION THEORY. Augustin, S. D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1974. Contract W-7405-eng-48. 156p. Dep. NTIS $10.75.

Thesis.

With the recent development of classical S-matrix theory, semiclassical methods have been applied to an increasing range of problems in collision dynamics. This work involves the application and improvement of older methods as well as the extension of classical S-matrix methods to systems more complex than those previously considered. A review is given of previous methods for treating electronic transitions in the collision of two atoms. The application of semiclassical methods to the calculation of the cross section for the ${}^4S \rightarrow {}^2D$ excitation of O^+ during collisions with ground state He is described. The formalism necessary for the application of classical S-matrix theory to collisions of an atom with a rigid asymmetric rotor is derived. The asymmetric rotor work is the first application of classical S-matrix methods to a collision involving a polyatomic molecule. The advantages and disadvantages of using action-angle variable for computing classical trajectories are considered. Classical trajectory calculations for the rotational excitation of CO by collisions with He at low energies are presented. A procedure by which the Jacobian factors necessary for the use of classical S-matrix theory can be calculated from perturbed classical trajectories is considered. (JFP)

4489 (LBL-3155) ANALYSIS OF DIRECT ION-MOLECULE REACTIONS. Mahan, B. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1974. Contract W-7405-eng-48. 34p. (CONF-740666-1). Dep. NTIS $4.75.

From ion-molecular reactions conference; Biarritz, France (24 Jun 1974).

The efficacy with which simple models for the reaction process can be used to understand and predict the energy and angular distributions of products, isotope effects, and total reaction cross sections is explored. A simple sequential model is used to analyze the dynamics of direct ion–molecule reactions. (JFP)

4490 (NP-20225) PHYSICS DISCIPLINE. Annual Progress Report, 1973. (Flinders Univ. of South Australia, Bedford Park, School of Physical Sciences). Dec 1973. 69p. Dep. NTIS (US Sales Only) $6.50.

Research being conducted in plasma physics includes such topics as wave propagation, high beta plasmas, shock waves and magnetohydrodynamics. Atomic physics work is proceeding in electron reactions, electron scattering from inert gases and atomic hydrogen, crossed field breakdown at low gas pressures, and transport parameters of electrons in hydrogen. Nuclear physics studies are centered on the three nucleon problems. Other topics include the binding energy of tritium, (p,2p) reactions and $(\alpha, 2\alpha)$ reactions. Research in statistical mechanics and solar energy is also reported. (AT)

4491 (SAND-74-0274) ENERGY DEPOSITION MECHANISMS FOR ELECTRONS COLLIDING WITH F_2 AND F_2 MIXTURES. Peek, J. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. 39p. Dep. NTIS $5.00.

The potentially important mechanisms and the available data for energy deposition by electrons colliding with targets consisting of F_2 and F_2 mixtures are reviewed. Since the target composition is a variable outside the scope of this review, very little discussion or data will be presented for species other than F_2. Fortunately, secondary literature sources have condensed much of the available data for most of the common gas additives. Many of these secondary literature sources will be discussed. As F_2 has received relatively little attention in the literature, the electronic structure of the F_2^+, F_2, and F_2^- systems is considered in detail. Available electron scattering data and some new inferences based on photon scattering information are presented. The literature search on which this work is based was terminated May 1, 1974. (auth)

4492 EFFECTIVE HAMILTONIAN DESCRIBING QUASI-HOMEOPOLAR STATES IN THE FRAMEWORK OF THE HUBBARD MODEL. Kapustin, V. A. (Ioffe Physical Technical Inst., Leningrad). Teor. Mat. Fiz.; 21: No. 1, 118-129(Oct 1974). (In Russian).

The graph technique for evaluation of the adiabatic S-matrix in the atomic limit of the Hubbard model is constructed. By means of this graph technique the generalization of the linked cluster expansion theorem for the S-matrix restriction to the 2^N-dimensional homeopolar subspace is proved (N is the number of sites in the lattice volume involved). The immediate consequence of this generalization is the existence of such an effective Hamiltonian describing quasihomeopolar excitations in the framework of the Hubbard model which includes no volume divergences in every order in the coupling constant. The graph rules for evaluation of this effective Hamiltonian are formulated. (auth)

4493 DESTRUCTION AND FORMATION OF NEGATIVE IONS IN SLOW COLLISIONS WITH ATOMS. Quantum-Mechanical Approach in the Case of Horizontal Position of the Continuous Spectrum Boundary. Devdariani, A. Z.; Demkov, Yu. N. (Leningrad State Univ.). Teor. Mat. Fiz.; 21: No. 1, 74-85(Oct 1974). (In Russian).

In the framework of the approximation of small range potential the problem of destruction of negative ions in the collision $A + B^-$ and the problem of formation of negative ions by scattering $A + B + e$ are considered. Unlike the previous works, the quantum-mechanical approach is used for describing the motion of atomic nuclei. The natural assumption that there is a weak dependence of the potential curve of AB on the internuclear distance reduced the problem to solving the Helmholtz equation on the half-plane with a mixed boundary condition which is a linear function of internuclear distance. An exact solution of the problem is obtained in analytic form. The cross section formula for the destruction of negative ions near the threshold is established. Conditions under which the formulas obtained agree with those known earlier are investigated. (auth)

4494 CLOSE COUPLING CALCULATIONS FOR MASSIVE ION—HYDROGEN ATOM COLLISIONS IN THE LINEAR TRAJECTORY MODEL. Msezane, A. Z. London, Ont.; Univ. of Western Ontario (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The Wilets and Gallaher (1966) formulation of H^+-H collision was generalized to the case of the heavy ion-atomic hydrogen collision. The resulting coupled differential equations were solved, and a computer program was constructed to extract numerical results. Calculations for the specific example of He^{2+}-H collision were carried out using both eigenfunction and pseudostate expansion bases. Charge transfer, excitation, and ionization cross sections are presented and compared with other theoretical calculations and experimental measurements where these are available. It is further shown that an eigenfunction expansion basis is unlikely to reproduce the 1.2° experiments of Keever et al., (1966) in a calculation involving a four-state approximation. (Diss. Abstr. Int., B)

4495 I. CHARGE TRANSFER AND EXCITATION IN COLLISIONS OF ALKALI IONS WITH ALKALI ATOMS. II. Approximate Solution of the Schroedinger Equation by Minimization of the Deviation. Chang, C. M. Dallas; Univ. of Texas (1973). 199p. University Microfilms Order No. 74-18,746.

Thesis (Ph. D.).

A pseudopotential model is set up for alkali atoms. Atomic wave functions are obtained by numerical integration of the Schrödinger equation for the pseudopotential. These atomic wave functions are used for charge transfer and excitation calculations using the impact parameter method. The overall magnitudes and energy dependences of the exchange cross sections agree with experimental results within the error of the experiment. However, the oscillatory structure predicted by theory is not in accord with the experiment. This is undoubtedly due to the inadequacy of the atomic expansion functions at small internuclear separations. Inclusion of parameters such as scale factors in the atomic wave functions will probably improve the calculations greatly. A method is proposed for dynamically adjusting parameters in the atomic functions during a collision by minimizing the deviation from the exact solution for the particular form of trial function chosen. It is hoped to apply this method in future work. (Diss. Abstr. Int., B)

4496 THEORY OF THE INELASTIC COLLISION OF AN ELECTRON WITH AN EXCITED ATOM. Nadezhin, A. D. (Central Aero-Hydrodynamic Inst., Moscow). Chislennye Metody Mekh. Sploshnoi Sredy; 2: No. 3, 79-84(1971). (In Russian).

The effective electron impact excitation cross section was calculated by using the method of excited stationary states. This involved solution of the three-body problem, representing the inelastic scattering of electrons on a hydrogen atom. The process considered involved the transition of a nucleus from one energy state to another in the field of a bound and an incident electron. At incident electron energies close to the threshold level the calculated cross sections were found to be considerably lower than those derived by classical calculations; this was attributed to the correct consideration of the interaction of the incident electron with the nucleus. At high energies the result agreed with those obtained by the Born approximation. (TTT)

4497 INNER SHELL VACANCY CREATION IN HIGH ENERGY HEAVY ION—ATOM COLLISIONS. Kubo, H. Rochester, NY; Univ. of Rochester (1974). 231p. University Microfilms Order No. 74-22,599.

Thesis (Ph. D.).

X-rays produced in high velocity (~MeV/nucleon) collisions between heavy ions (atomic number Z_1) and a variety of target atoms ranging from potassium to uranium (atomic number Z_2 = 19 to 92) were detected with a high resolution (~180 eV) high efficiency lithium drifted silicon detector. The purpose of these experiments was to determine the cross section for x-ray production (estimate of inner shell vacancy production) and to investigate whether a molecular orbital process is a valid interpretation of the mechanism for the creation of vacancies in inner atomic shells. The projectiles used were nickel ($Z_1 = 28$) and bromine ($Z_1 = 35$) ions. The nickel projectiles had incident energies of 45, 61, and 94 MeV; the bromine projectiles had energies of 45, 60, 85, and 110 MeV. The thickness of the targets ranged between 15 and 25 microgram per cm^2. This use of thin target foils eliminated many of the problems of data reduction which arise as a consequence of x-ray absorption and the energy loss of the heavy ions in the target material. Furthermore, the use of thin targets allows a separate particle detector to be used to measure elastically scattered particles. This makes it possible to normalize x-ray cross sections directly with Rutherford elastic scattering, since the latter can be calculated absolutely. The present data indicate that the molecular orbital (MO) process for inner shell vacancy production is still an important ingredient at 1.6 MeV/nucleon. One consequence of this fact is that there is a strong preference for the production of inner shell vacancies in the lighter of the target and projectile atoms. The data show that even at energies as high as 1.6 MeV/nucleon, Coulomb excitation processes are less important than molecular orbital effects. These effects give qualitative explanations of the observed enhancement of the target K-shell x-ray yield and the Z-dependence of the target L-shell cross sections. (Diss. Abstr. Int. B)

4498 INTERACTION POTENTIAL AND REACTION DYNAMICS OF He(2^1S,2^3S) +Ne, Ar BY THE CROSSED MOLECULAR BEAM METHOD. Chen, C.H.; Haberland, H.; Lee, Y.T. (The James Franck Institute and Department of Chemistry, The University of Chicago, Chicago, Illinois 60637). J. Chem. Phys. 61: No. 8, 3095-3103 (15 Oct 1974).

Differential elastic scattering cross sections of metastable He(2^1S) and He(2^3S) with Ne and Ar were measured at thermal collision energies by the crossed molecular beam method. The interaction potentials of these systems are found to be similar to those of alkali—rare gas systems. The excitation transfer from He(2^1S) to Ne and the Penning and associative ionization processes in He(2^1S,2^3S) and Ar collisions only occur when interatomic distances are shorter than given critical values and interaction potentials are repulsive. The ratios of associative to Penning ionization cross sections were also measured for collisions of metastable He(2^1S,2^3S) and Ar as a function of collision energies. These results combined with the opacity function derived from differential elastic scattering cross sections of He(2^1S,2^3S) and Ar provide some information on the long range interaction of He + Ar^+. (auth)

4499 INTERATOMIC POTENTIALS FOR KRYPTON AND XENON. Barker, J.A. (IBM Research Laboratory, San Jose, California 95193); Watts, R.O.; Lee, J.K.; Schafer, T.P.; Lee, Y.T. J. Chem. Phys. 61: No. 8, 3081-3089 (15 Oct 1974).

Accurate potentials for ground state krypton—krypton and xenon—xenon interactions are derived using a wide range of experimental evidence including second virial coefficients, gas transport properties, solid state data, known long—range interactions, spectroscopic information on dimers, and new measurements of differential scattering cross sections. In calculating solid—state properties account is taken of long—range many—body interactions. The use of the potentials permits a critical intercomparison of various kinds of experimental data. A "corresponding states" comparison of the shapes of the potentials for different inert gas pairs is given. It is concluded that contributions of overlap—dependent many—body interactions to condensed—phase properties of argon, krypton, and xenon are very small. (auth)

4500 SEMICLASSICAL TREATMENT OF ATOM—ASYMMETRIC ROTOR COLLISIONS; ROTATIONAL EXCITATION OF FORMALDEHYDE AT LOW ENERGIES. Augustin, S.D.; Miller, W.H. (Department of Chemistry, and Inorganic Materials Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). J. Chem. Phys. 61: No. 8, 3155-3163 (15 Oct 1974).

The formalism necessary for the application of "classical S—matrix" theory to collisions of an atom with a rigid asymmetric rotor is derived. This is applied to rotational excitation of formaldehyde by H_2 (taken to be spherically symmetric) at energies from 10 to 15°K. Classical Monte Carlo trajectory calculations were also carried out for the same system in the energy range 10—40°K. The results support the proposal of Townes and Cheung that a collisional mechanism is responsible for the $1_{11} \rightarrow 1_{10}$ anomalous absorption of formaldehyde in cool interstellar dust clouds. (auth)

4501 SEMICLASSICAL COLLISION THEORY. MULTIDIMENSIONAL INTEGRAL METHOD. Kreek, H.; Marcus, R.A. (Department of Chemistry, University of Illinois, Urbana, Illinois 61801). J. Chem. Phys. 61: No. 8, 3308-3312 (15 Oct 1974).

Numerical results on the integral expression for the semiclassical S matrix are compared with exact quantum results for a multidimensional problem. The collision of a rigid rotor with an atom is treated. The integral method proves to be easy to apply. Within its range of maximum validity (no sign changes in the pre—exponential factor of the semiclassical wavefunction) the agreement was typically within 20%. When sign changes occurred, the agreement was about a factor of 2 or better. Conditions affecting sign changes are described. (auth)

4502 PRODUCT ENERGIES FOR $N_2^+ + O_2 \rightarrow N_2 + O_2^+$. Neynaber, R.H.; Magnuson, G.D. (Intelcom Rad Tech, P. O. Box 80817, San Diego, California 92138). J. Chem. Phys. 61: No. 8, 3490-3491 (15 Oct 1974).

Total relative kinetic energy of the products of the charge transfer reaction $N_2^+ + O_2 \rightarrow N_2 + O_2^+$ was obtained by a merging beam technique. The results presented have not been reported before. (AIP)

4503 REACTIONS BETWEEN ISOTOPICALLY LABELED $N^+{}_2$ AND N_2 FOR PRIMARY ION ENERGIES BELOW 45 eV. Maier, W.B. II (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). J. Chem. Phys. 61: No. 8, 3459-3470 (15 Oct 1974).

Apparent cross sections for electron transfer between $^{15}N^+{}_2$ and $^{14}N_2$ and for the reactions (1) $N^+{}_2 + N_2 \rightarrow N^+{}_3 + N$, and (2) $N^+{}_2 + N_2 \rightarrow N^+ + N + N_2$ have been measured, with the primary ion and target molecules isotopically labeled. The laboratory kinetic energies E of $N^+{}_2$ are between 3 and 45 eV. The effect of excited states of $N^+{}_2$ is studied. Reactions (1) and (2) proceed both by processes which involve dissociation of the primary $N^+{}_2$ and by processes which involve dissociation of the target N_2. Processes which involve dissociation of the primary ion are favored, and even more so when the primary $N^+{}_2$ is excited by ~8.5 eV to unidentified, long–lived states. The isotopic composition of the reactants influences Reactions (1) and (2) significantly; these isotopic effects may be caused by kinematic phenomena. It is suggested that Reaction (1) proceeds via stripping processes which convert most of the reactants' kinetic energy into internal energy of the $N^+{}_3$ and/or N products. Reaction (2) may proceed either through the formation and disintegration of excited $N^+{}_3$ or through some unidentified mechanism. A survey of the available information on $N^+{}_2$ suggests that the production and lifetimes of the various states of $N^+{}_2$ may now be well–enough known to permit detailed comparisons between theory and experiment. (auth)

4504 ROTATIONAL–VIBRATIONAL COUPLING IN THE THEORY OF ELECTRON–MOLECULE SCATTERING. Temkin, A.; Sullivan, E.C. (Theoretical Studies Group, Goddard Space Flight Center, National Aeronautics Space Administration, Greenbelt, Maryland 20771). Phys. Rev. Lett. 33: No. 17, 1057-1060 (21 Oct 1974).

The adiabatic–nuclei approximation of vibrational–rotational excitation of homonuclear diatomic molecules can be simply augmented to describe the vibrational–rotational coupling by including the dependence of the vibrational wave function on j. Appropriate formulas are given and the theory is applied to $e-H_2$ excitation whereby it is shown that deviations from the simple Born–Oppenheimer approximation measured by Wong and Schultz can be explained. More important, it can be seen that the inclusion of the j–dependent centrifugal term is essential for transitions involving high–rotational quantum numbers. (auth)

4505 RADIATIVE CHARGE TRANSFER FROM H ATOMS BY FAST IONS. Briggs, J.S.; Dettmann, K. (Institut für Festkörperforschung der Kernforschungsanlage Jülich, 517 Jülich, West Germany). Phys. Rev. Lett. 33: No. 19, 1123-1125 (4 Nov 1974).

The cross section for radiative electron transfer from H atoms to bound states of an incident ion is calculated for velocities much greater than the orbital velocity of the captured electron. It is shown to dominate over the Coulomb–charge–exchange cross section for $E > 9$ MeV per incident nucleon. (auth)

4506 ELECTRON CAPTURE AND EXCITATION IN COLLISIONS OF He^{2+} WITH H. II. CONVERGENCE OF THE ATOMIC EXPANSION. Rapp, D. (The University of Texas at Dallas, Dallas, Texas 75230). J. Chem. Phys. 61: No. 9, 3777-3779 (1 Nov 1974).

Cross sections for excitation and single electron capture in collisions of He^{2+} with H(1s) were calculated in a travelling wave atomic orbital, impact parameter model. Previous calculations utilized either seven or eight state expansions, and unfortunately the eight state calculations contained an error. In this paper, the eight state calculations are corrected and in addition, 11 state results are also presented. The theory is compared with new data, and while the theoretical cross section for total exchange is in moderate agreement with experiment, the cross section for electron capture into the 2s state of He^+ shows a large divergence between theory and experiment. (auth)

4507 VIBRATIONAL EXCITATION OF HCl BY ELECTRON IMPACT. Center, R.E.; Chen, H. (AVCO Everett Research Laboratory, Inc., Everett, Massachusetts 02149). J. Chem. Phys. 61: No. 9, 3785-3788 (1 Nov 1974).

Measurements have been made of the vibrational excitation rate constant of HCl excited by electron impact. The experiments were performed in a uniform electron beam sustained discharge over the range of average electron energies from 0.8 to 1.7 eV. A mean value of $(1.2 \pm 0.4) \times 10^{-8}$ cm^3/sec was obtained corresponding to a cross section of several Å^2. It was also determined that the vibrational excitation by electron impact was predominantly to the first vibrational level with only 20% probability of exciting the second or higher levels. (auth)

4508 NONRESONANT BEHAVIOR OF THE SYMMETRIC CHARGE–TRANSFER CROSS SECTION FOR DEUTERIUM MOLECULES. Rothwell, H.L.; Van Zyl, B.; Amme, R.C. (Department of Physics and Astronomy, University of Denver, Denver, Colorado 80210). J. Chem. Phys. 61: No. 9, 3851-3852 (1 Nov 1974).

In this Communication cross section measurements for the symmetric charge–transfer of deuterium molecular ions on deuterium molecules are reported. The process studied is $D_2{}^+ + D_2 \rightarrow D_2 + D_2{}^+$. A detailed theoretical calculation of this cross section, made by Stocker and Neumann (following Communication), served as the basic motivation for the study. (AIP)

4509 CHARGE TRANSFER IN $D_2{}^+-D_2$ COLLISIONS. Stocker, R.N.; Neumann, H. (Department of Physics and Astronomy, University of Denver, Denver, Colorado 80210). J. Chem. Phys. 61: No. 9, 3852-3853 (1 Nov 1974).

Total charge transfer cross sections for $D_2{}^+$ in any of the lowest four vibrational states incident on D_2 in the ground vibrational state have been calculated for impact energies between 50 eV and 10 keV by a semiclassical impact parameter method similar to, but more complete than, one used previously by Bates and Reid [Proc. R. Soc. A 310, 1 (1969)] for $H_2{}^+ + H_2$ collisions. (AIP)

4510 SOURCES OF ROTATIONAL CROSS SECTION ASYMMETRY $\sigma(J \rightarrow J + \Delta J)/\sigma(J \rightarrow J - \Delta J)$ IN MOLECULE–ATOM AND MOLECULE–MOLECULE SYSTEMS. Verter, M.R.; Rabitz, H. (Department of Chemistry, Princeton University, Princeton, New Jersey 08540). J. Chem. Phys. 61: No. 9, 3707-3719 (1 Nov 1974).

Asymmetries are investigated for the rotationally inelastic transitions $J \rightarrow J + \Delta J$ and $J \rightarrow J - \Delta J$. Previous cross section expressions are extended to handle the case of two colliding symmetric top molecules. Asymmetries are shown to arise from (1) the previously considered interference terms in the cross sections, (2) angular momentum coupling effects, and (3) $R \rightleftharpoons T$ energetic effects. It is shown that symmetric top molecules with threefold or higher symmetry axes are not likely to exhibit interference asymmetries unless high–order tensor terms are important in the intermolecular potential. However, substantial asymmetries can still arise from angular momentum coupling and energetic effects. The conditions for the dominance of these sources of asymmetry are discussed and investigated numerically for the molecules HCl, HCN, and OCS perturbed by Ar and Xe as well as the systems HCl:HCl, HCN:HCN, OCS:OCS, HCl:OCS, and NH_3:NH_3. In these latter cases, the first molecule in each pair is the observed species and the second constitutes a thermal bath. Angular momentum coupling asymmetries are found to be important only at small J. Energetic asymmetries are particularly important for systems with large rotational constants. (auth)

4511 CROSSED BEAM STUDY OF THE REACTION OF H_3^+ WITH D_2. Vestal, M. L.; Blakley, C. R.; Ryan, P. W.; Futrell, J. H. (Univ. of Utah, Salt Lake City). Chem. Phys. Lett.; 27: No. 4, 490-492(15 Aug 1974).

The kinematics of the reaction $H_3^+(D_2, H_2)D_2H^+$ were studied over the initial relative energy range from 0.22 to 5.21 eV for ground state reactants. The reaction was found to proceed via a direct mechanism at all energies studied. Indirect evidence suggests, however, that substantial complex formation may occur at energies below about 0.2 eV. (auth)

4512 INTERACTION POTENTIALS FOR UF_6 WITH ITSELF AND WITH RARE-GAS ATOMS. Schneider, B.; Boring, A. M.; Cohen, J. S. (Los Alamos Scientific Lab., NM). Chem. Phys. Lett.; 27: No. 4, 577-579(15 Aug 1974).

Potential curves were calculated for the UF_6-UF_6 and UF_6–rare gas atom interactions using statistical models for the UF_6 charge density, and the intermolecular interaction. Agreement with available experimental data is good. (auth)

4513 THEORY OF THE RAINBOW. Khare, V.; Nussenzveig, H. M. (Univ. of Rochester, NY). Phys. Rev. Lett.; 33: No. 16, 976-980(14 Oct 1974).

A new theory of the rainbow is proposed and compared with the exact Mie solution. There is good agreement over a much broader range of angles and size parameters than for the Airy theory. The improvement is particularly remarkable for electric polarization. The treatment can be extended to atomic, molecular, and nuclear rainbow scattering. (auth)

4514 PRIMITIVE ANGULAR DISTRIBUTION STUDIES OF INTERNAL STATES IN CROSSED-BEAM REACTIONS USING LASER FLUORESCENCE DETECTION. Dagdigian, P. J.; Zare, R. N. (Columbia Univ., New York). J. Chem. Phys.; 61: No. 6, 2464-2465(15 Sep 1974).

Angular distribution studies are performed on individual internal states in the reaction $Ba + LiCl \rightarrow BaCl + Li$ in which the BaCl product is kinematically constrained to lie close to the centroid. The excitation spectra and the angular distributions of the various vibrational states are shown. (JFP)

4515 K-SHELL IONIZATION OF Pb AT ZERO IMPACT PARAMETER IN 50- TO 100-MeV Cl + Pb COLLISIONS. Burch, D.; Ingalls, W. B.; Wieman, H.; Vandenbosch, R. (Univ. of Washington, Seattle). Phys. Rev., A; 10: No. 4, 1245-1254(Oct 1974).

The absolute ionization probability at zero impact parameter was measured in a coincidence experiment at incident Cl-ion energies of 50 to 100 MeV. Total K-shell ionization cross sections are also reported over a larger energy range. The data are compared with theoretical predictions based on the assumption of pure Coulomb ionization as formulated in the binary-encounter approximation (BEA), the semiclassical approximation (SCA), and the plane-wave Born approximation. It is shown that the good agreement of the total cross sections with nonrelativistic calculations using a straight-line, constant-velocity projectile trajectory is to a large extent due to a fortuitous cancellation of the inadequacies of this oversimplified model. Recent impact-parameter formulations of the BEA model, including corrections for projectile retardation and deflection and an approximate treatment of relativistic effects, qualitatively reproduce the observed energy dependence of the cross sections and ionization probabilities but overestimate the absolute values by about a factor of 3. Approximate, closed-form, SCA results without these corrections also reproduce the energy dependence but underestimate the ionization probability by a factor of 2 to 3. (auth)

4516 SIMULTANEOUS IONIZATION AND EXCITATION OF Ar BY ELECTRONS WITH PARTICULAR ATTENTION TO CONFIGURATION-INTERACTION EFFECTS. Tan, K. H.; McConkey, J. W. (Univ. of Windsor, Ont.). Phys. Rev., A; 10: No. 4, 1212-1222(Oct 1974).

Absolute apparent cross sections for electron impact excitation of the 4s′, 5s, 3d, 4d, 5d, 3d′, and 4d′ configurations of Ar^+ from the ground state of Ar are presented by studying the vacuum uv photon decay of the states. The high energy behavior of the excitation functions is demonstrated to reflect the two-electron nature of the initial excitation. Where the cascade can be satisfactorily taken into account, excitation of states with the same orbital angular momentum and multiplicity is shown to be according to their statistical weights. Some significant discrepancies are exposed between theoretically calculated and experimentally measured relative transition probabilities. Configuration-interaction effects are demonstrated to exist in a number of instances and are quantitatively investigated for the $^2S_{1/2}$ states. (auth)

4517 ELECTRON CAPTURE BY POSITRONS FROM ATOMIC HYDROGEN USING THE SECOND BORN AND PADE APPROXIMATIONS. Sural, D. P.; Barman, S. (Jadavpur Univ., Calcutta). Phys. Rev., A; 10: No. 4, 1162-1166(Oct 1974).

The cross sections for electron capture by positrons from atomic hydrogen are calculated using the second Born approximation and the method of Pade approximants for incident positron energy ranging from 12 to 500 eV. The results are compared with those obtained in the first Born approximation and other theoretical calculations. The contributions from the intermediate states higher than the first to the second-order rearrangement scattering amplitude are found to be significant. The nature of the variation of the second Born and the Pade differential cross sections with the angle of scattering is discussed. (auth)

4518 PHOTOELECTRIC CROSS SECTIONS FOR 279.1 keV AND 411.8 keV γ RAYS. Gowda, R.; Sanjeevaiah, B. (Univ. of Mysore, India). J. Phys., B (London); 7: No. 13, 1772-1775 (11 Sep 1974).

Photoelectric cross sections of copper, zirconium, silver, tin, tantalum, gold and lead for 279.1 keV and 411.8 keV γ rays have been measured using the well-type plastic scintillation spectrometer. This method is similar to the one used for determining the photoelectric cross sections for 145 keV γ rays, which have been reported in an earlier paper by the authors (J. Phys. A. Math. Nucl. Gen.; 6: 1041-5(1973)). The values are found to be in good agreement with the predicted values of Schmickley and Pratt (Phys. Rev.; 164: 104-16(1967)) and recent calculations of Scofield (UCRL Report No. 51326 (unpublished)). (auth)

4519 THRESHOLD STRUCTURE IN THE ELASTIC CROSS SECTION FOR SCATTERING OF SLOW ELECTRONS FROM HCl AND HBr. Burrow, P. D. (Yale Univ., New Haven). J. Phys., B (London); 7: No. 13, L385-L388(11 Sep 1974).

Sharp structure in the differential cross section for elastic scattering of electrons from HCl and HBr is observed at the threshold for excitation of the first vibrational level of the electronic ground state. (auth)

4520 ELASTIC SCATTERING OF ELECTRONS BY ARGON. Gupta, S. C.; Rees, J. A. (Univ. of Liverpool). J. Phys., B (London); 7: No. 13, L381-L384(11 Sep 1974).

Measurements of the differential elastic scattering of electrons of 100 and 110 eV energy in argon and in a (5 : 95) mixture of argon with helium are reported. The absolute scale of the cross sections is established by reference to available data for helium. (auth)

4521 DIFFERENCES IN K X RAY PRODUCTION CROSS SECTIONS AND X RAY SPECTRA MEASURED IN $Ar-Cl_2$ AND IN Ar−Ar, Ar−HCl COLLISIONS. Saris, F. W. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam); Foster, C.; Langenberg, A.; van Eck, J. J. Phys., B (London); 7: No. 12, 1494-1505(21 Aug 1974).

Cross sections for K-shell x ray production in collisions of Ar with Ar, HCl and Cl_2 have been measured in the energy range 0.25 to 2.2 MeV. These experiments show unambiguously that K-shell ionization does occur in symmetric systems with an atomic number larger than 10, under adiabatic and single collision conditions. Yet, the cross sections are so small that the results are not necessarily in contradiction with the molecular model. Observed differences in cross sections and spectra for $Ar-Cl_2$, as compared with Ar−Ar, Ar−HCl, are speculated to be due to double scattering in the Cl_2 molecule. Ar-2p vacancies created in the first collision can, during collision with the second Cl atom of the same molecule, lead to promotion of Cl-K electrons via $2p\pi-2p\sigma$ rotational coupling, promotion of Ar-K electrons via $2p\pi-1s\sigma$ rotational coupling, and the production of MO x rays. These speculations are consistent with experimental results. A calculated cross section for K-shell ionization via $2p\pi-2p\sigma$ rotational coupling is shown to be in good agreement with the Cl-K ionization cross section in $Ar-Cl_2$ double scattering deduced from the experimental results. (auth)

4522 ELECTRON−PHOTON ANGULAR CORRELATIONS IN ELECTRON−HELIUM COLLISIONS. Measurements of Complex Excitation Amplitudes, Atomic Orientation, and Alignment. Eminyan, M.; MacAdam, K. B.; Slevin, J.; Kleinpoppen, H. (Univ. of Stirling, Scotland). J. Phys., B (London); 7: No. 12, 1519-1542(21 Aug 1974).

Electron−photon angular correlations were measured by delayed coincidences between electrons scattered inelastically from helium and 58.4 nm photons emitted in the decay of the 2^1P state. The ratio of the differential cross sections for exciting the degenerate magnetic sublevels and the relative phase of the corresponding excitation amplitudes for electron scattering angles between 16° and 40° and for incident electron energies in the range 40 to 200 eV are deduced. The data show that a high degree of atomic orientation is produced by collisions in this range of energy and angle. The orientation increases rapidly towards its theoretical limit as the scattering angle is increased, and higher incident energy produces, in general, greater orientation at a fixed scattering angle. The data also show that the alignment of the atomic dipole radiation pattern can depart significantly from the direction of linear momentum transfer at the larger scattering angles. The results are compared with the predictions of the first Born and Glauber approximations, and it is observed that good agreement is obtained with a recent distorted-wave calculation. (auth)

4523 QUANTAL CLOSE-COUPLING CALCULATIONS ON FINE-STRUCTURE TRANSITIONS IN RUBIDIUM−NEON COLLISIONS. Wilson, A. D.; Shimoni, Y. (Hebrew Univ., Jerusalem). J. Phys., B (London); 7: No. 12, 1543-1557(21 Aug 1974).

Fully quantal close-coupling calculations of the cross sections for fine-structure and depolarization transitions in Rb(S^2P)−Ne collisions are presented. The calculations proceed by analogy with collision-induced rotational excitation (Reid and Dalgarno. Phys. Rev. Lett.; 22: 1029-30(1969) and Chem. Phys. Lett.; 6: 85-6(1970)). They were performed using the interaction potentials of Baylis (Private communication (1973)) and of Hidalgo and Geltman (J. Phys. B. Atom. Molec. Phys.; 5: 265-76(1972) and private communication (1972)) at both high and low energy. The quantal calculations using the Hidalgo−Geltman potential are compared with the Hidalgo−Geltman semi-classical calculations and are found to be in reasonable agreement. The Baylis potential gives good agreement with experiment for the depolarization cross sections and the low-energy inelastic cross section. Improvement in the repulsive potential should improve the high-energy inelastic results. The results suggest that Nikitin's second mechanism (Coriolis coupling between the Π quasi-molecular states at short interatomic distances) is to be favored over the first (coupling between the $\Pi_{1/2}$ and $\Sigma_{1/2}$ states at intermediate distances) for Rb−Ne collisions. (auth)

4524 ELASTIC AND THE 2 ^1S AND 2 ^1P INELASTIC DIFFERENTIAL CROSS SECTIONS FOR PROTON−HELIUM SCATTERING. Flannery, M. R.; McCann, K. J. (Georgia Inst. of Tech., Atlanta). J. Phys., B (London); 7: No. 12, 1558-1561 (21 Aug 1974).

Differential cross sections for $H^+-He(1s^2)$ elastic and inelastic collisions in the keV-energy region are calculated using various approximate schemes. (auth)

4525 POSITRON−HELIUM SCATTERING LENGTH. Moussa, A. H. (Ain Shams Univ., Cairo); Radi, H. M. A. J. Phys., B. (London); 7: No. 12, 1562-1566(21 Aug 1974).

The Kohn variational method has been applied to the zero-energy positron–helium collisions. Results show that singularity persists in scattering length values, for variant IV of Peterkop and Rabik (J. Phys. B. Atom. Molec. Phys.; 4: 1440-9(1971)), which may suggest that this method is not, after all, reliable. (auth)

4526 ELECTRON CAPTURE BY VERY FAST PROTONS FROM HYDROGEN ATOMS. A Further Examination of the Continuum Distorted Wave Approximation. Shakeshaft, R. (New York Univ.). J. Phys., B (London); 7: No. 13, 1734-1740 (11 Sep 1974).

In a previous paper a variational form of the continuum distorted wave approximation was used to calculate a variational expression for the cross section for resonant ground state capture at very high velocities in proton–hydrogen atom collisions. In this paper the previous work is extended in that the cross section is calculated by first calculating a variational expression for the transition amplitude. The resulting cross section is found to have the form $\sigma \simeq 2^6 \pi \gamma v^{-11} (\pi a_0^2)$, where the velocity v is in atomic units, $\gamma = 4 \exp(2.0) E_2(2.0)$, and $E_2(z)$ is the exponential function. This cross section differs from the high-velocity limit of the cross section obtained in the second Born approximation, and in any other second-order approximation. However, the present approximation is thought to be poor at large impact parameters so that the above result should probably not be taken too seriously. (auth)

4527 ANGULAR DIFFERENTIAL CROSS SECTIONS FOR ELASTICALLY SCATTERED ELECTRONS IN HELIUM. Sethuraman, S. K.; Rees, J. A.; Gibson, F. R. (Univ. of Liverpool). J. Phys., B (London); 7: No. 13, 1741-1747(11 Sep 1974).

Differential elastic scattering cross sections for electrons in helium have been measured for electron energies of between 100 and 500 eV for angles of between 30 and 150°. The data have been normalized to Bromberg's (J. Chem. Phys.; 50: 3906-21(1969)) measured cross section for 500 eV electrons at 60°. The present measurements are compared with other available data, in particular with the recent work of Crooks and Rudd (Bull. Amer. Phys. Soc. II; 17: 131(1973)) and Winters et al (J. Phys. B. Atom. Molec. Phys.; 7: 788-98(1974)). (auth)

4528 SCATTERING OF SLOW POSITRONS BY HYDROGEN MOLECULES. Hara, S. (University Coll., London). J. Phys., B (London); 7: No. 13, 1748-1755(11 Sep 1974).

The fixed-nuclei approximation is used to investigate elastic and momentum transfer cross sections for collision between a positron with incident energy less than 10 eV and a hydrogen molecule. The scattering wavefunctions and phase shifts thus obtained are used to calculate the rotational excitation cross section in the adiabatic-nuclei approximation, and also the effective number of annihilation electrons of the molecule. (auth)

4529 BETHE THEORY FOR THE POLARIZATION OF IMPACT RADIATION. McFarlane, S. C. (Univ. of Stirling, Scotland). J. Phys., B (London); 7: No. 13, 1756-1771(11 Sep 1974).

On the basis of a kinematic analysis of the direction of momentum transfer, the Bethe theory is applied to the polarization of atomic line radiation by electron impact. A simple, analytic formula is obtained for the line polarization P as a function of impact energy. This formula depends on only two parameters: P_0, the threshold polarization (exactly calculable), and C_n, which occurs in the Bethe excitation cross section formula. Comparison is made with the first Born approximation and with experiment for a number of He lines. Good agreement is generally obtained with the Born over a wide energy range, the two converging as the energy increases. Cascade effects appear insufficient to account for the gap between both theories and experiment. By using Moeller's adaptation (Ann. Phys.; 14: 531-85(1932)) of the Bethe theory, the polarization formula is extended to relativistic impact velocities. It is demonstrated that relativistic effects increase the polarization substantially for collision energies >1 MeV. (auth)

4530 POTENTIAL ENERGY CURVES AND EXCITATION TRANSFER CROSS SECTION OF EXCITED HYDROGEN ATOMS. Capitelli, M.; Guidotti, C.; Lamanna, U. (Univ., Bari, Italy). J. Phys., B (London); 7: No. 13, 1683-1691(11 Sep 1974).

The complete set of potential energy curves arising from the interaction between H(1s) and H(3s, 3p, 3d) has been computed by means of the Heitler–London method. These values have been used for calculating the excitation transfer cross section of the process H(1s) + H(3s, 3p, 3d) = H(3s, 3p, 3d) + H(1s) as a function of the relative energy. The results have been compared with the corresponding values for the principal quantum number 2. (auth)

4531 DISSOCIATIVE IONIZATION OF THE HYDROGEN MOLECULE. Bottcher, C. (Univ. of Manchester, Eng.). J. Phys., B (London); 7: No. 11, L352-L357(1 Aug 1974).

The experimental results of Crowe and McConkey (Phys. Rev. Lett.; 31: 192-6(1973)) on the dissociative ionization of H_2 by electron impact are compared with theoretical calculations on the autoionizing states of H_2. The structure of their proton production spectra can be interpreted as evidence for the existence of four autoionizing states. Calculated cross sections agree semiquantitatively with experiment. Cross sections have also been calculated for the ejection of electrons by impact and photoionization. (auth)

4532 ENERGY LOSS SPECTRA FOR VIBRO-ROTATIONAL MOLECULAR EXCITATION IN AN IMPULSIVE SPECTATOR MODEL. Eckelt, P.; Korsch, H. J.; Philipp, V. (Univ., Muenster, Ger.). J. Phys., B (London); 7: No. 13, 1649-1665(11 Sep 1974).

Inelastic collisions between ionized atoms and molecules within the energy range 1 to 25 eV (centre of mass system) are treated in an impulsive quantum-mechanical spectator model. The model allows extensive calculations of the energy distribution over the final rotational and vibrational states. Qualitative information on the dependence of these "energy loss spectra" on the collision energy and on the scattering angle is obtained from numerical calculations, based on an idealized model of the system $N_2 + Li^+$. Comparison is also made with experimental data for $H_2 + H^+$ scattering. (auth)

4533 MOLECULAR TREATMENT OF THE He^{2+}–H COLLISIONS. Piacentini, R. D.; Salin, A. (Univ. Nacional de Rosario, Argentina). J. Phys., B (London); 7: No. 13, 1666-1678(11 Sep 1974).

The collision of He^{2+} with H(1s) is studied in the impact parameter (eikonal) approximation by expanding the wavefunction on a set of electronic states of the molecule HeH^{2+}. Exact eigenenergies and matrix elements between the states of this basis set are used in the calculations. The results for the total charge-exchange cross section are in good agreement with the experimental data. The structures observed experimentally in the variation of the charge-exchange probability as a function of energy for a fixed scattering angle are fairly well reproduced in our theory. However, the origin of these structures is not that proposed by Keever and Everhart (Phys. Rev.; 150: 43-7 (1966)) on the basis of their experimental work. (auth)

4534 APPLICATION OF FIRST ORDER MANY-BODY THEORY TO THE CALCULATION OF THE DIFFERENTIAL AND INTEGRAL CROSS SECTIONS FOR THE ELECTRON IMPACT EXCITATION OF THE 2^1S, 2^1P, 2^3S, 2^3P STATES OF HELIUM. Thomas, L. D.; Csanak, G.; Taylor, H. S.; Yarlagadda, B. S. (Univ. of California, Los Angeles). J. Phys., B (London); 7: No. 13, 1719-1733(11 Sep 1974).

The first-order form of the many-body theory for inelastic scattering (called random phase approximation) has been applied in the 29.6 eV ≤ E ≤ 81.63 eV energy region for the electron impact excitation of the 2^1S, 2^1P, 2^3S, 2^3P states of helium. Differential and integral cross sections are calculated and compared with recent experiments. The results for each state are discussed and compared with other calculations. (auth)

4535 BORN CROSS SECTIONS FOR THE TRANSITIONS BETWEEN HIGHLY EXCITED STATES OF ATOMS INDUCED BY ELECTRON IMPACT. Beigman, I. L.; Urnov, A. M. (Inst. of Physics, Moscow). J. Quant. Spectrosc. Radiative Transfer; 14: No. 10, 1009-1023(Oct 1974). (In Russian).

The total Born cross sectiohs summed over the orbital quantum numbers, as well as the corresponding excitation rates for transitions between highly excited states induced by electron impact, are calculated. The calculations were made for the following principal quantum numbers: $10 \leq n \leq 100$, $\Delta n/n \leq 0.3$ ($\Delta n = n| - n'|$). The results are presented in a form convenient for interpolations. The calculations were performed by using an asymptotic expansion in powers of $1/n$ and $1/n'$ for the exact analytical expression of the total generalized oscillator strength. Comparison of the exact results with the asymptotic ones shows that an accuracy of about 10 percent is achieved for $n \gtrsim 2$. For high electron energies, analytical expressions are obtained for the cross sections and the excitation rates. The approximation used is analogous to that of Kramers for the oscillator strength: the errors do not exceed ~30%. (auth)

4536 STEADY-STATE FLOWING AFTERGLOW METHOD. Twiddy, N. D. (University Coll. of Wales, Aberystwyth). Contemp. Phys.; 15: No. 5, 427-444(Sep 1974).

In the last decade the study of ion–neutral reactions has been dramatically advanced by the development and energetic exploitation of the steady-state flowing afterglow method by Ferguson et al. (Adv. Atom. Molec. Phys.; 5: 1 (1969) and Ferguson (Rev. Geophys. Space Phys.; 9: 997-1008(1971)). This new technique has provided a very large number of ion–molecule rate coefficients for reactions at thermal energy. In this method a fast flow of carrier gas (usually helium) is established in a long flow tube, the reactant ions (A^+) are generated near the gas input end of the tube (the excitation region) and these ions are carried along the tube in the carrier gas flow. The neutral reactant (B) is introduced into the flowing gas stream near the mid-point of the flow tube so that the reaction $A^+ + B \rightarrow$ products takes place along the remainder of the tube length (the reaction region). The reactant ion A^+ and any ions produced in the reaction are monitored by a mass spectrometer located at the gas exit end of the tube. The variation of the A^+ mass spectrometer signal as a function of neutral injection rate B yields the rate coefficient k for the reaction if gas flow rates and tube dimensions are known. The great advantage and versatility of the steady-state flowing afterglow system lies primarily in the separate control that can be exercised over the ions and the neutrals prior to the reaction and also to the fact that the atomic processes occurring in the afterglow are susceptible to many diverse forms of investigation such as emission and absorption spectroscopy, laser spectroscopy, microwave interferometry and Langmuir probes, as well as mass spectrometry. Furthermore, chemically unstable neutral particles can be readily studied in these systems. (auth)

4537 PENNING IONIZATION. Shaw, M. J. (University Coll. of Wales, Aberystwyth, Eng.). Contemp. Phys.; 15: No. 5, 445-464(Sep 1974).

Penning ionization is a fundamental atomic collision process whereby ions are produced in chemical reactions involving excited atoms. The process has been known since the 1920s but until fairly recently has been poorly understood. Over the past decade new experimental techniques such as metastable beams, flowing afterglows and Penning electron spectroscopy have produced a wealth of data on the process and have prompted the development of new theories. The process is now well described by the concept of an excited quasi-molecule which undergoes auto-ionization. In this article are described the recent experimental and theoretical work which has led to a new understanding of the process. (auth)

4538 ROTATIONAL EXCITATION OF $N_2^+B\ ^2\Sigma_u^+$ PRODUCED IN COLLISIONS OF ATOMIC HYDROGEN WITH N_2. Birely, J. H. (Aerospace Corp., Los Angeles, CA). J. Phys., B (London); 7: No. 11, L350-L351(1 Aug 1974).

The rotational excitation of $N_2^+B\ ^2\Sigma_u^+$ formed in collisions of 20 keV with N_2 is shown to be adequately characterized by a Boltzmann Distribution having a rotational temperature equal to the kinetic temperature of the nitrogen target. (auth)

4539 IONIZATION IN $He(2^3S) + He$ COLLISIONS. Evidence of a Diabatic Mechanism. Gillen, K. T.; Lorents, D. C.; Olson, R. E.; Peterson, J. R. (Stanford Research Inst., Menlo Park, CA). J. Phys., B (London); 7: No. 11, L327-L331(1 Aug 1974).

Differential cross section measurements of the ionization of metastable He* atoms in collisions with ground state He have been performed in the energy range $E = 50$ to 199 eV. The most prominent peak in the energy loss distributions of the product ions occurs near the ionization threshold ($\Delta E \approx 5$ eV), implying the ejection of very-low-energy electrons. The angular distribution of this prominent feature is very strongly peaked at 0°, displaying no apparent angular threshold, and its intensity increases substantially with increasing collision energy. This behavior is consistent with a mechanism in which a small fraction of the incident flux follows the diabatic $^3\Sigma_g^+$ potential of $He(2^3S) + He$. Ionization occurs as this state crosses the continuum state $He_2^+\ (^2\Sigma_u) + e$, near the bottom of its potential well. (auth)

4540 ELECTRON CAPTURE AND LOSS IN COLLISIONS OF 100- TO 500-keV OXYGEN IN MOLECULAR HYDROGEN. Olsen, J. O.; Hvelplund, P. (Aarhus Univ., Denmark). J. Phys., B (London); 7: No. 11, 1331-1338(1 Aug 1974).

Absolute cross sections for single-electron capture and single- and multiple-electron loss by 100- to 500-keV oxygen atoms and ions in collision with H_2 gas molecules have been measured. The charge-state distribution of the fast beam emerging from the target cell was measured by electrostatic separation of the various components and subsequent counting by a secondary-emission, position-sensitive detector. Cross sections were determined from non-equilibrium charge-state distributions by a least-squares technique. (auth)

4541 ELASTIC AND 2s AND 2p INELASTIC SCATTERING OF ATOMIC HYDROGEN BY HELIUM-IONS. Flannery, M. R.; McCann, K. J. (Georgia Inst. of Tech., Atlanta). J. Phys. B (London); 7: No. 11, 1349-1357(1 Aug 1974).

Differential cross sections are presented in the Born, unitarized Born, two- and four-state treatments of the elastic and the 2s and 2p inelastic scattering of H(1s) by He^+(1s), with impact speeds ν_i in the range $0.5 \leq \nu_i \leq 3$ au. For elastic collisions, the Born approximation is successful only for large-angle scattering, while for inelastic scattering it fails completely for large angles at all ν_i, and for small angles at low ν_i, when the effects of couplings to other close channels are important. Corresponding treatments are also carried out for $H^+-H(1s)$ collisions, which represent the behavior of $He^+(1s)-H(1s)$ collisions in the limit of high-impact-energies when the valence electron in He^+(1s) completely screens its parent nucleus. (auth)

4542 ELASTIC AND INELASTIC DIFFERENTIAL MEASUREMENTS FOR H^+ ON H COLLISIONS IN THE 250 eV–2000 eV ENERGY RANGE. Houver, J. C.; Fayeton, J.; Barat, M. (Univ., Paris). J. Phys., B (London); 7: No. 11, 1358-1369(1 Aug 1974).

Differential measurements are reported on elastic, charge exchange and direct excitations for H^+ on H between 250 eV and 2000 eV, using the energy loss method. Evidence is found for the exclusive excitation of n = 2 levels. Charge exchange probabilities are in good agreement with the previous data of Helbig and Everhart (Phys. Rev.; 140: 1715-20(1965)) and improve them at low energies and angles. Experimental cross sections for every process are compared with the available theoretical data in the molecular expansion, this comparison revealing the effect of "trajectory" calculations for large angles. (auth)

4543 SECOND BORN APPROXIMATION TO THE ELASTIC SCATTERING OF ELECTRONS AND POSITRONS BY HELIUM ATOMS. Buckley, B. D.; Walters, H. R. J. (Queen's Univ., Belfast). J. Phys., B (London); 7: No. 11, 1380-1400(1 Aug 1974).

A widely occurring error in the evaluation of the closure term in the simplified second Born approximation to electron–helium scattering is corrected. The corrected theory is applied to the elastic scattering of electrons and positrons by the 1 ^{1}S ground state of helium in the energy range 50 eV to 800 eV. The full second Born approximation, in which cross sections are calculated by squaring the modulus of the full second Born amplitude, and the third-order second Born approximation, in which the second Born cross section is only evaluated correct to third order in the interaction potential, are both shown to be poor. A modification of the second Born approximation first used in the original work of Massey and Mohr (Proc. R. Soc.; A146: 880-900(1934)) is adopted. This "new" approximation gives special treatment to the coupling of the 1 ^{1}S state to itself. The results obtained are in much better agreement with experiment. Exchange effects are also taken into account in electron–helium scattering and appear to be important up to quite high energies. Positron–helium differential cross sections are found to be smaller and flatter than the corresponding electron cross sections. (auth)

4544 INELASTIC COLLISIONS BETWEEN HYDROGEN AND HELIUM ATOMS. Bell, K. L.; Kingston, A. E.; Winter, T. G. (Queen's Univ., Belfast). J. Phys., B (London); 7: No. 11, 1339-1348(1 Aug 1974).

A study is made of the excitation of atomic hydrogen to the 2s, 2p, 3s, 3p and 3d states by collision with helium and of excitation of the 2 ^{1}S and 2 ^{1}P states of helium by collision with atomic hydrogen. The first Born approximation is employed to calculate total cross sections (with full account taken of double transitions) for 3s, 3p and 3d excitation and to calculate the polarization of Lyman α radiation emitted from H(2p). The effect of coupling of states is investigated for single transition reactions (the target atom remaining in its ground state) occurring in all the above excitations by employing the impact parameter method and including ten states. When coupling is considered, theory and experiment are in excellent accord for 2s and 2p excitation for impact energies greater than about 6 and 30 keV, respectively, and are in satisfactory agreement for the polarization of Ly α radiation. For excitation of the 3s, 3p and 3d states, theory and experiment are in good agreement for the 3s states, but theory gives results which for the 3p state are a factor of 2 greater than experiment and for the 3d state are a factor of 3.5 below experiment. Comparison of first Born approximation and close coupling results indicates that, for helium 2 ^{1}S, 2 ^{1}P excitation, effects due to coupling are not significant for hydrogen impact energies greater than about 35 keV. (auth)

4545 ATOMIC PROCESSES. Burke, P. G. (Queen's Univ., Belfast). pp 1-63 of Atoms and Molecules in Astrophysics. Carson, T. R. (ed.). New York; Academic Press Inc. (1972).

From 12th session of Scottish universities summer school in physics atoms and molecules in astrophysics; Stirling, UK (Aug 1971). See CONF-710859-.

A theoretical treatment is given for potential scattering, electron scattering by hydrogen atoms and hydrogen-like ions, electron scattering by complex atoms and ions, photoionization and recombination, and molecular processes. (JFP)

4546 DISORIENTATION OF ^{3}He ^{1}D STATES IN ^{3}He–^{3}He COLLISIONS. Pinard, M.; van der Linde, J. (Ecole Normale

Superieure, Paris). Can. J. Phys.; 52: No. 17, 1615-1621(1 Sep 1974).

Cross sections were measured for the disorientation of the 3 ^{1}D, 4 ^{1}D, and 5 ^{1}D states of ^{3}He in collisions with the ground state atoms. Oriented n ^{1}D state atoms are produced by exciting in a discharge ^{3}He atoms whose nuclei were oriented by optical pumping. The role of hyperfine coupling is investigated and the theoretical treatment of the effect of collisions on the orientation of the excited atom, which does not require instantaneous recoupling of the nuclear spin I and the electronic angular momentum J after each collision, is presented. (auth)

4547 ELECTRON EXCHANGE AND VIBRATIONAL EXCITATION IN $H_2^+ + H_2$ AND D_2^+ COLLISIONS. Stocker, R. N. Denver; Univ. of Denver (1974). 177p. University Microfilms Order No. 74-24,669.

Thesis (Ph. D.).

A semi-classical impact parameter method was used to calculate electron exchange cross sections for $H_2^+ + H_2$ and $D_2^+ + D_2$ collisions in the center of mass energy range from 25 eV to 5 keV. Initial ion and neutral vibrational quantum numbers were $v' = 0$-3 and $v = 0$, respectively. The numerous vibrational states that become populated, particularly at higher energies, were represented by 12 basis functions divided into 2 sets: the set of the lowest-lying 6 pairs of asymptotic vibrational states and a set of 6 mixed states (linear combinations of pairs of asymptotic vibrational states) chosen for their strong coupling to states in the first set. Throughout the energy range, calculated cross sections agree reasonably well with available measurements. In agreement with experiment, total charge transfer cross sections tend to decrease slightly with increasing v'. High energy cross sections are ordered in magnitude according to Franck-Condon factors for the transition. (Diss. Abstr. Int., B)

4548 FREDHOLM METHOD IN ELECTRON-ATOM SCATTERING. Rescigno, T. N. Boston; Harvard Univ. (1973). 194p. University Microfilms Order No. 74-33,221.

Thesis (Ph. D.).

Baker and Schwinger pointed out a relation between the Fredholm determinant of the partial-wave Lippmann-Schwinger equation and the potential scattering phase shift. Subsequent developments by Newton and Blankenbecler extended these results to show how the entire S-matrix for multi-channel scattering could be formally calculated from a scalar-valued Fredholm determinant. Various aspects of the Fredholm method are developed and their feasibility tested by numerical application to a variety of model problems. After a brief review of the Fredholm method it is shown that by treating the centrifugal barriers as part of the physical potential, scattering information for arbitrary values of l may be obtained without using the usual distorted wave basis of spherical Bessel functions, in spite of the formal divergence of the Fredholm series in this case. One move away from the idea of using continuum functions to perform scattering calculations. By numerical analytic continuation of the Fredholm determinant from the complex energy plane, it is shown that phase shifts may be obtained over a continuous range of energies from calculations performed solely with square-integrable (L^2) basis functions. The use of L^2 basis functions in the Fredholm method is examined more closely. For certain basis sets, an "equivalent quadrature" relation allows one to perform elastic scattering calculations with L^2-functions directly at real energies. An extension of the L^2-Fredholm method is developed to allow for application to multi-channel scattering problems. By using basis functions with complex coordinates to implicitly perform certain contour distortions, the multisheeted Fredholm determinant is "unfolded" to allow for calculation of the S-matrix. The various methods are combined and applied to the problem of electron-hydrogen atom scattering at energies above the ionization threshold of hydrogen where a continuum of channels is open. A pseudostate expansion is used to calculate the Feshbach optical potential for complex energies. The scattering problem is then solved by constructing the Fredholm determinant in a set of L^2-functions with complex coordinates. Singlet elastic cross sections for $L = 0$ and 1 were calculated over an energy range of 10 to 30 eV. (Diss. Abstr. Int., B)

4549 INVESTIGATION OF THE SPECTRAL LINE EXCITATION FUNCTIONS FOR Na, K, Rb, AND Cs IONS IN THE VACUUM ULTRAVIOLET SPECTRAL RANGE. Aleksakhin, I. S.; Vukstich, V. S.; Zapesochnyi, I. P. (Uzhgorod State Univ., USSR). Zh. Eksp. Teor. Fiz.; 66: No. 6, 1973-1980(Jun 1974). (In Russian).

Excitation of resonance transitions of NaII, KII, RbII and CsII in the 30 to 100 nm spectral range is investigated for the first time by the intersecting electron and atomic beam technique at energies ranging from the threshold of the process up to 500 eV. From an analysis of the data and their comparison with theoretical calculations of p-ionization, it follows that in the near-threshold energy region p-ionization for rubidium and cesium is strongly masked mostly by excitation of inner s-electrons to the $nsnp^6n'l'n''l''$ states; due to Auger decays the latter lead to additional population of resonance levels. For NaII, on the other hand, the experimental excitation function of resonant transitions directly reproduces the p-ionization process. (auth)

4550 INTERSECTING BAND MODEL FOR THE INTERACTION BETWEEN CLOSELY APPROACHING ATOMIC PARTICLES. Afrosimov, V. V.; Gordeev, Yu. S.; Zinov'ev, A. N. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 66: No. 6, 1933-1944(Jun 1974). (In Russian).

The interaction between two many-electron atomic particles is considered for strong collisions when the inner electron shells overlap. Due to the pronounced nonadiabaticity of the collision the system cannot be described by separated terms, and a large number of states are involved in the interaction. It is suggested that the behavior of the system at small internuclear distances be described by a small number of energy bands. Each band corresponds to a certain state of the inner shells and possesses a certain width, since the state of the outer shell is not fixed and may vary. This description is justified since the energy change on transitions of the inner electron is much greater than the band width, as well as the magnitude of the nonadiabatic perturbation. Transitions between bands will therefore be possible only if they are close to each other or intersect. Such transitions are analyzed by solving a model problem in which the bands are represented as a set of discrete terms. Transitions between terms of various bands in the intersection region and also transitions between terms of a given band resulting from nonadiabatic coupling are considered. Transition probabilities are obtained for single traversal of the band intersection region. The course of the bands for Kr-Kr and Ar-Ar systems is determined on the basis of the experimental data and by employing the model. The latter explains the high probability for formation of inner vacancies, the singularities in the scattering differential cross sections and the satisfactory applicability of adiabatic interaction potentials for describing scattering in strong collisions between atomic particles. (auth)

4551 ION CYCLOTRON RESONANCE COLLISION FREQUENCIES OF ALKALI IONS IN RARE GASES. Riggin, M. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 52: No. 17, 1683-1693(1 Sep 1974).

An ion cyclotron resonance (ICR) spectrometer was used to estimate collision frequencies of K^+ and Na^+ ions at near thermal velocities in helium and argon gases. The reduced zero field d.c. drift mobilities were found to be 11.4 and 40.7 $\text{cm}^2\ \text{PMU}^{1/2}/\text{V s}$ for $^{39}K^+$ in Ar and He respectively and 11.6 and 42.8 $\text{cm}^2\ \text{PMU}^{1/2}/\text{V s}$ for Na^+ in these gases. The effect of ion-neutral collisions on the energy distribution function for ions at resonance with an oscillating electric field is discussed and the average ionic energy as a function of neutral particle density obtained. In deriving the ICR line shape and ionic energy distribution function it is assumed that the mean time between momentum changing collisions is independent of the relative ion-neutral velocity. (auth)

4552 BORN CROSS SECTION FOR VIBRATIONAL EXCITATION OF A POLYATOMIC MOLECULE BY ELECTRON COLLISIONS. Itikawa, Y. (Tokyo Univ.). J. Phys. Soc. Jap.; 36: No. 4, 1121-1126(Apr 1974).

A cross section formula is obtained for the electron-impact vibrational excitation of a polyatomic molecule, with the use of the Born approximation. An average over initial and a sum over final rotational states are taken. The resulting formula is applied to the cases where electron-molecular multipole interactions dominate and where polarization force is also important. (auth)

Atomic Theory

Refer also to abstracts 4535, 4683, 5098, 5102, 5103, and 5520.

4553 (COO-1674-100) BASIC STUDIES OF ATOMIC DYNAMICS. Progress Report, October 1, 1973-September 30, 1974. Fano, U. (Chicago Univ., Ill. (USA)). 30 Sep 1974. Contract AT(11-1)-1674. 8p. Dep. NTIS $4.00.

This year's activity was marked by major progress on the two-electron problem and by completion of initial development and testing of a novel method for calculating R matrices directly in their diagonal form. The two-electron system appears to pass from one channel to another in the critical region of configuration space (electrons equidistant from the center and on opposite sides) which was identified by Wannier as controlling ionization at threshold. This result may have very great significance. The same may hold for the R-matrix work. Continuing experience with methods developed in earlier years confirms their usefulness but also shows that much refinement and pedagogical work is needed to secure their impact. Other activities have progressed more slowly. A list of publications is included. (auth)

4554 QUANTUM THEORY OF COHERENT SPONTANEOUS AND STIMULATED EMISSIONS. Smithers, M. E. St. Louis; Washington Univ. (1974). 84p. University Microfilms Order No. 74-22,546.

Thesis (Ph.D.).

The objective is to give a quantum-theoretical treatment of coherent spontaneous and stimulated emissions. The model adopted is a system of many two-level atoms or molecules in a collective Dicke state interacting only with the single resonant mode of the quantized radiation field. The information that can be extracted from the model and which corresponds most closely to the real world is the photon statistics of coherent or cooperative emissions. Exact closed form solutions and photon statistics of coherent spontaneous and stimulated emissions are obtained for a variety of the model atom-field states in the limit of infinitely large cooperation number. Depending on the initial excitation level of the atoms, three limiting cases—the low excited, the superradiant, and the highly inverted—are considered. For spontaneous emission by a Dicke state, three distinct types of photon statistics are obtained: "sub-Poisson," Poisson, and "super-Poisson;" these correspond to the low excited, the superradiant, and the highly inverted limiting cases, respectively. In addition, it is found that in both the spontaneous and stimulated cases the emitted pulses can be described in terms of Glauber coherent states only if the initial Dicke states are superradiant. In all other cases the photon distributions undergo large fluctuations. For an initial atomic coherent state interacting with a Glauber state, the resulting field can be represented as a Glauber state in the low excited limiting case, but not otherwise. Due to the complexity of the problem, the results are found via two independent methods, the mutual consistency of which is checked. The first method is to directly solve the Schroedinger equations of motion by Laplace transform techniques. In the second method advantage is taken of a contraction of the angular momentum algebra to the harmonic oscillator algebra in the limit of infinitely large cooperation number. The latter method is especially helpful in obtaining the photon statistics of the emitted field when more complicated initial states are involved. (Diss. Abstr. Int., B)

4555 PERTURBATION CALCULATION USING THOMAS-FERMI MODEL. Suh, Y. B. (Louisville Univ., Ky. (USA)). Phys. Lett., A; 49: No. 2, 99-100(26 Aug 1974).

The possible perturbation calculation using TF [Thomas-Fermi] potential for heavy atoms is discussed together with the criteria for its validity. This simplifies mathematics involved in the TF potential by using the Coulomb potential instead. (auth)

4556 QUANTUM ELECTRODYNAMIC SOURCE-FIELD METHOD: FREQUENCY SHIFTS AND DECAY RATES IN SINGLE ATOM SPONTANEOUS EMISSION. Ackerhalt, J. R. (Rochester, NY; Univ. of Rochester (1974). 147p. University Microfilms Order No. 74-22,555.

Thesis (Ph. D.).

In the spirit of Lorentz's classical work on radiation damping, spontaneous emission in atomic quantum electrodynamics is considered. An equation-of-motion method is developed that permits working directly with the relevant dynamical variables. Three specific, related problems are treated in detail. These problems are: a two-level atom coupled to all modes of the quantized radiation field; the Jaynes-cummings model problem of a two-level atom coupled to a single mode of the quantized radiation field. In order to treat these problems, paralleling classical physics as closely as possible, the Heisenberg picture is used throughout. An operator perturbation method is introduced which makes explicit use of the operator source field radiated by the atom under consideration. In those problems treated where atomic decay occurs, Lorentz's ideas of radiation reaction are found to be entirely adequate in a calculation of lowest order radiative corrections. In the cases of interest these radiative corrections are exactly the relevant Lamb shift and Einstein's spontaneous decay coefficient. The Heisenberg equations of motion which characterize the quantum electrodynamic spontaneous emission process are of course, only integrated approximately. It is therefore necessary to establish that the approximations are not inconsistent with the unitarity of the time evolution operator. The method's unitarity is established by explicitly showing the self-consistency of the canonical commutation relations. The Jaynes-Cummings model admits exact solutions to the problem of spontaneous emission. Since one can also attack this model problem by the QED source-field method and Dirac's constants-of-the-motion method, a comparison of the exact and approximate solutions can be made. Comments are made on Dirac's method with respect to the source-field method specifically emphasizing the calculation of radiative corrections and the solutions' time evolution. (Diss. Abstr. Int., B)

4557 SPLINE REPRESENTATION. I. LINEAR SPLINE BASES FOR ATOMIC CALCULATIONS. Gilbert, T.L.; Bertoncini, P.J. (Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 61: No. 8, 3026-3036 (15 Oct 1974).

The use of a basis of cardinal splines for atomic calculations with the expansion method is proposed. The basis has the property that the coefficients C_p in the orbital expansion $\varphi(r) = \Sigma^{N+1}{}_{p=-1} C_p \chi_p(r)$ are given by $C_{-1} = \varphi(r_0)$, $C_p = \varphi(r_p)$, $p = 0,1,\ldots,N$, and $C_{N+1} = \varphi'(r_N)$, where $r_0, r_1,\cdots,r_N$ is the mesh of knots on which the spline is defined. The basis functions $\chi_p(r)$ are continuous with continuous first and second derivatives, and may readily be calculated from the expansion $\chi_p(r) = \Sigma_{k=1}^{N} \Sigma_{s=0}^{3} r^s d_k(r)\, S_{ksp}$, where $d_k(r) = 1$ if $r_{k-1} \leq r < r_k$ and 0 otherwise and S_{ksp} is a matrix of coefficients which are uniquely determined by the mesh alone and may be constructed by simple algebraic operations, the most complex being the inversion of a single $(N+1) \times (N+1)$ matrix. Atomic Hartree—Fock matrix elements are given by simple polynomial expressions. The number of two—electron integrals increases only as the square of the number of basis functions and can be stored in factored form, so that the storage requirements for the two—electron integrals are trivial. The largest two arrays (equal in size) are the density matrix and the matrix elements of the exchange operator. The results of numerical tests for the hydrogen atom using several different distributions of mesh points are presented. It is found that the number of mesh points required is smaller than for standard numerical methods by a factor of about 4. The accuracy of a linear spline representation with N+1 knots is comparable to that of a Gaussian expansion with N basis functions. (auth)

4558 NOTE ON THE SYMMETRY OF PERTURBED HARTREE—FOCK AND X—α WAVEFUNCTIONS. Eaves, J.O.; Epstein, S.T. (Theoretical Chemistry Institute, University of Wisconsin, Madison, Wisconsin 53706). J. Chem. Phys. 61: No. 8, 3486-3488 (15 Oct 1974).

It is shown that the first order orbitals for X—α or Hartree—Fock closed shell atoms perturbed by multipole electric fields have the expected symmetry properties.(AIP)

4559 GEOMETRIC DOUBLE—PERTURBATION EXPANSION OF THE COUPLED HARTREE—FOCK SECOND—ORDER ENERGY. Nakatsuji, H.; Musher, J.I. (Belfer Graduate School of Science, Yeshiva University, New York, New York 10033). J. Chem. Phys. 61: No. 9, 3737-3741 (1 Nov 1974).

The second—order energy of the coupled perturbed Hartree—Fock (CHF) theory is expanded explicitly into the sum with respect to the electron—correlation corrections. In a matrix form, the expansion is exactly geometric. The correlation effect included in the CHF theory has two origins: one represents the so—called first—order correlation energies intrinsic to the unperturbed ground and excited states, and the other represents the correlation effect induced by the external perturbation. The matrix geometric expansion reduces under some approximation to an ordinary scalar geometric series. This gives a basis for the geometric approximation of the CHF energy proposed empirically by Schulman and Musher. Exactly the same arguments also apply to the second—order energy of the singly excited CI method, simply by neglecting the perturbation—induced correlation effect. (auth)

4560 INEQUALITIES FOR ELECTRON REPULSION INTEGRALS. Okninski, A. (Inst. of Organic Chemistry, Warsaw). Chem. Phys. Lett.; 27: No. 4, 603-605(15 Aug 1974).

A uniform derivation of general inequalities for electron repulsion integrals is given. Upper bounds for electron repulsion integrals may be defined by one-electron integrals as well as by other two-electron integrals. (auth)

4561 ELECTRON CORRELATION STUDY FOR TWO-ELECTRON ATOMS BY A SIMPLE CORRELATED WAVE FUNCTION. Kagawa, T.; Murai, T. (Nara Women's Univ., Japan). Int. J. Quant. Chem.; 8: No. 5, 755-764(Sep 1974).

The difference in the electron correlation between H^- and other two-electron atoms is clarified by the introduction of the r_{12} term in the wave function. By using the expansion of r_{12}, a certain modification of the usual electron correlation factor $1 + Cr_{12}$ is introduced and its effectiveness is examined. Calculations are carried out for the ground state and the three lowest excited states (2^3S, 2^3P and 2^1P). The peculiar electron correlation in the ground state of H^- is shown by looking at the Coulomb hole for closed- and open-shell models in comparison with those for other two-electron atoms. (auth)

4562 RELATIVE SIZES OF HIGH AND LOW SPIN STATES OF ATOMS. Boyd, R. J. (Univ. of British Columbia, Vancouver). Nature (London); 250: No. 5467, 566-567(16 Aug 1974).

It is stated that x-ray structural studies of five- and six-coordinated iron porphyrin complexes have shown that the distance from the Fe atom to the N atoms of the porphyrin rings is less for low-spin Fe(III) than for high-spin Fe(III), and that it is often assumed that the Fe(III) atom is larger in its high-spin state than in its low-spin state. The relative sizes of the high- and low-spin states of atoms are here discussed in terms of the results of quantum mechanical calculations for isolated atoms. Contrary to earlier interpretations of structural studies, it was found that for the atoms studied the lowest-lying high-spin state of an atom in a given configuration is smaller than any lower spin state. It was found that the He atom is smaller by 19% in the high-spin $2\,^3S$ state than in the $2\,^1S$ state, and for Be^{2+} the $2\,^3S$ state is smaller than the $2\,^1S$ state by 10%. (UK)

4563 MULTIPHOTON ABSORPTION BY ATOMS. Choudhury, B. J. (Univ. of Manitoba, Winnipeg). Phys. Lett., A; 48A: No. 5, 333-334(15 Jul 1974).

A theory of multiphoton transition in atoms by a reasonably strong electromagnetic field was outlined. The theory treats the perturbation consistently and takes into account the higher-order processes associated with the multiphoton transitions approximately through the mean frequency approximation. (auth)

4564 CORIOLIS INTERACTION IN ADIABATIC REPRESENTATION OF THREE-BODY PROBLEM. Vinitskii, S. I.; Ponomarev, L. I. (Joint Inst. for Theoretical Research, Dubna, USSR). Yadern. Fiz.; 20: No. 3, 576-588(Sep 1974). (In Russian).

For a system of three spinless particles (two nuclei and an electron) in the adiabatic basis a one-dimensional system of differential equations is obtained that represents the relative motion of the nuclei with account of the Coriolis interaction of the electron and nuclear motions. The obtained equations are suitable for numerical computations and admit a generalization to the case of particles with spin. The effective potentials of the system are presented as operators in spherical, spheroidal and parabolic coordinates before averaging over the adiabatic basis. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

4565 (AD-781044) MAGPIE: A USER'S MANUAL. Final Report, December 1973–April 1974. Stockman, H. S. Jr. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Jun 1974. 55p. (AFWL-TR-74-120). NTIS $3.75.

A user's guide for MAGPIE, a one-dimensional lagrangian magnetohydrodynamics (MHD) computer code, has been prepared. MAGPIE is suitable for cylindrical geometries of conducting and insulating materials, whose equations of state are either provided by the code or the user. Although time-dependent boundary conditions can be employed by the user, MAGPIE is capable of solving an external series circuit. As an example, an exploding wire problem has been run with MAGPIE. The resulting velocities and current features agree qualitatively with experimental findings. (auth)

4566 MAGNETOHYDRODYNAMIC (MHD) METHODS OF MEASURING MASS VELOCITY AND ELECTRICAL CONDUCTIVITY WHICH ARE VARYING IN THE DIRECTION OF FLOW. Ershov, A. P. Zashch. Pokrytiya Metal.; No. 4, 108-113(1974). (In Russian).

Consideration is given to contact measurements of mass velocity and electrical conductivity which varied along the MHD channel. Conditions were found under which it was possible to measure the mass velocity profile, and the measurement error was estimated. It is shown that MHD measurements of electrical conductivity are possible with a previously unknown mass velocity profile. (SJR)

4567 WAVES IN A POLARIZING AND MAGNETIZING MEDIUM. Ermakov, V. I.; Tarapov, I. E. Magn. Gidrodin.; No. 2, 51-57(1974). (In Russian).

Small-amplitude waves and simple waves in a nonconducting medium which can be isotropically and inhomogeneously magnetized and polarized in electromagnetic fields were examined. The case of an ideal gas was analyzed in detail. The anisotropy of the propagation of the waves and instability of the state of the medium were established. (tr-auth)

4568 MAGNETOHYDRODYNAMICAL THEORY OF RELATIVE EQUILIBRIUM OF QUASISTATIONARY ROTATING SELF-GRAVITATING LIQUID FIGURES. Oganesyan, R. S.; Abramyan, M. G. (Erevan State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 9: No. 1, 90-93(1974). (In Russian).

The problem of the relative equilibrium of quasistationary rotating figures of selfgravitating ideally-conducting liquid in the presence of the toroidal magnetic field are considered. It is shown that the existence of the quasistationary rotation involves a poloidal magnetic field, which provides the relative equilibrium of the system as a series of spheroidal figures. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 3537, 3538, 4053, 4059, 4633, 4641, 4642, and 5004.

4569 (CERN-74-9(Vol.1), pp 5-18) CERN AND ITS WORK. Hine, M. G. N. (CERN, Geneva). 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

As an introductory talk to the CERN Meeting on Technology arising from High-Energy Physics, this paper sets out with a brief description of the place of high-energy physics as the latest step in basic research into the structure of matter. It then discusses how the nature of the physics demands large, complex, and costly equipment relying on advanced technology for accelerating particles, observing their properties and analyzing the results of experiments. After describing the CERN facilities in European high-energy research, it is shown how the concentration of research in one laboratory leads to efficient use of equipment, but demands high reliability and operational flexibility. The closing section summarizes the aims of the meeting: to show the industry and government science planners the technology and designs needed to meet these unusual specifications, and to improve CERN's communication with the outside world in technological and industrial, as opposed to scientific, fields. (auth)

4570 (CERN-74-9(Vol.1), pp 27-33) SOME ASPECTS OF THE REALIZATION OF HIGH-ENERGY PROJECTS IN CERN. Zilverschoon, C. J. (CERN, Geneva). 15 Jun 1974.

From meeting on technology arising from high-energy physics; Geneva, Switzerland (24 Apr 1974).

General features of high-energy projects are outlined. It is indicated that although these projects are normally large, complicated, and technologically advanced, in general they meet the cost and time estimates rather well. The aspects discussed include: project set-up and control at CERN; the kind of staff, their work and motivation; collaboration with industry and the possibility of "fall-out" products. (auth)

4571 (JINR-D1,2-7781, pp 465-479) COMPUTER COMPLEX OF THE JINR AND ITS FUTURE DEVELOPMENT. Govorun, N. N.; Karlov, A. A.; Meshcheryakov, M. G.; Polyakov, V. N.; Chulkov, N. I.; Shirikov, V. P.; Shchelev, S. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From third international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

4572 (LNF-74/7(R)) COMPARATIVE STUDY OF HADRON FRAGMENTATION WITH THE SPS. Amendolia, S. R.; Baroncelli, A.; Bellini, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 11 Feb 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

A comparative study of inelastic hadron production at the SPS, by means of a single multiparticle spectrometer is proposed. While only a preliminary description of the detectors is contained in this document, the general philosophy of the measurement and the procedure with which it is planned to collect and to handle the information are discussed in detail. (auth)

4573 (UH-511-108-71) ANNUAL PROGRESS REPORT OF THE HIGH ENERGY PHYSICS GROUP. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). 19 Oct 1971. Contract AT(04-3)-511. 150p. Dep. NTIS $10.50.

Experimental and theoretical research on high energy physics is summarized. A list of publications is included. (JFP)

4574 SEARCH FOR COSMIC RAY QUARKS AT LARGE ZENITH ANGLES. Kifune, T. (Tokyo Univ.); Hieda, Y.; Kurokawa, S.; Tsunemoto, K.; Kimura, Y. J. Phys. Soc. Jap.; 36: No. 3, 629-633(Mar 1974).

Fractionally charged particles (quarks) were looked for in cosmic rays at sea level. The detection system consists of six layers of scintillation counter hodoscopes, and is directed to large zenith angles so that quarks are detected isolated from air showers due to their interactions with the thick atmospheric layer. The total acceptance of the present measurement amounts to 1.1×10^{10} cm^{2}sr sec. The upper flux limit of 3×10^{-10} cm^{-2} sr^{-1} sec^{-1} is obtained for e/3 quarks at large zenith angles. From this flux limit, a lower limit of the quark mass is estimated to be about 20 GeV/c^2. (auth)

Electromagnetic

4575 MEASUREMENT OF INCLUSIVE HADRON ELECTROPRODUCTION FROM HYDROGEN AND DEUTERIUM. Dakin, J.T.; Feldman, G.J.; Martin, F.; Perl, M.L.; Toner, W.T. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 5, 1401-1418 (1 Sept 1974).

We report on the inclusive electroproduction of hadrons from nucleon targets. The incident electron beam energy is 19.5 GeV. We detect scattered electrons corresponding to exchanged virtual photons in the range $-0.25 > q^2 > -3.00$ (GeV/c)^2 and $12 < s < 30$ GeV^2. In coincidence we detect most hadrons which go in the forward (virtual photon) direction in the virtual photon–nucleon c.m. system. The cross section for producing these hadrons is studied as a function of azimuthal angle, transverse momentum squared, and a longitudinal–momentum–related variable. Data are presented for proton, deuteron, and neutron targets, and are largely consistent with the data in real photoproduction ($q^2 = 0$). Notable differences are that in electroproduction the transverse momentum distributions are somewhat broader, and the forward hadrons are less charge– and isospin–symmetric. The data are generally consistent with expectations of parton models. (auth)

Weak

4576 (JINR-D1,2-7781, pp 398-402) SEARCH FOR THE DECAYS $\mu^+ \rightarrow e^+ + e^+ + e^-$ AND $\pi^+ \rightarrow e^+ + \nu_e + e^+ + e^-$. Korenchenko, S. M.; Kostin, B. F.; Mitsel'makher, G. V.; Nekrasov, K. G.; Smirnov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From third international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

4577 FINAL STATES PRODUCED IN DEEPLY INELASTIC MUON–PROTON SCATTERING. Seiden, A. Santa Cruz, CA; Univ. of California (1974). 161p. University Microfilms Order No. 74-23,015.

Thesis (Ph.D.).

The final states produced in deeply inelastic muon–proton scattering were studied using a specially designed streamer chamber and liquid hydrogen target. This chamber provides nearly full solid angle detection for all charged secondaries and is designed to accept several hundred beam particles per memory time. The muon beam for the experiment is a very high quality beam; beam parameters at the liquid hydrogen target are 1 cm × 1 cm size, ±2 milliradian angles in each plane, ±1% momentum bite for a central momentum of 14 GeV/c, 1% beam halo, and a flux $\sim 2.5 \times 10^4$ muons per second. Three thousand events were analyzed to date with half of these coming from the $Q^2 \geq .5$ region. Based on this data sample the following features are found: Elastic and inelastic cross sections agree with the values previously reported for electron-proton scattering. The cross section for ρ^0 production continues to fall in comparison to the inelastic cross section in the $Q^2 \geq 1$ region. The slope in the ρ^0 momentum transfer distribution tends to decrease at high Q^2 as compared to the photoproduction value. Charged multiplicities and prong cross sections show almost no Q^2 dependence out to $Q^2 \sim 3$. The averaged charge multiplicity can be fit by the formula $.66 + \ln W^2$ for all Q^2 and W, where W = center of mass energy for the interaction. The final data sample from this experiment will be about five times the present sample. An approximately equal amount of data was also taken with a deuterium filled target. (Diss. Abstr. Int., B)

4578 EXPERIMENTAL MEASUREMENT OF THE FORM FACTORS OF THE $K_L^0 \rightarrow \pi e \nu$ DECAY. Nagy, J. Philadelphia; Univ. of Pennsylvania (1974). 278p. University Microfilms Order No. 74-22,884.

Thesis (Ph. D.).

This experiment measures the form factors of the decay of the long lived neutral kaon into a pion, electron, and neutrino ($K_L^0 \rightarrow \pi^{\pm} e^{\pm} \nu$). These results first of all place the best upper limit to date on the amount of scalar and tensor interaction in the strangeness changing weak interaction current thus supporting the V-A theory. The measurement of the q^2 variation of the vector form factor $f_+(q^2)$ agrees with the world average of previous $K_L^0 \rightarrow \pi e \nu$ experiments. It also agrees with the form factor for $K^{\pm} \rightarrow \pi e \nu$, a test of the $\Delta I = \frac{1}{2}$ rule. The experimental values for the $K_{\mu 3}$ decays have not stabilized but comparison would be a test of the $e-\mu$ universality. The data are insufficient to distinguish between linear, higher order polynomial, monopole, or dipole models for the vector form factor. (Diss. Abstr. Int., B)

4579 SEARCH FOR EXCITED MUONS. Gittleson, H.; Kirk, T.; Murtagh, M.; Tannenbaum, M.J. (Harvard University, Cambridge, Massachusetts 02138); Entenberg, A.; Jöstlein, H.; Kostoulas, I.; Melissinos, A.C.; Lederman, L.M.; Limon, P.; May, M.; Rapp, P.; Sculli, J.; White, T.; Yamanouchi, T. Phys. Rev. D 10: No. 5, 1379-1386 (1 Sept 1974).

We have searched for the production of excited muons via a missing—mass analysis of the spectrum of recoil protons emitted when muons interact in liquid hydrogen. No evidence is seen for the production of an excited muon of mass between 0.0 and 2.0 GeV. (auth)

Strong (Baryon-induced)

Refer also to abstracts 3555, 4709, 4778, 4895, and 4906.

4580 (BNL-19026) TOTAL CROSS SECTIONS OF $\pi^\pm$, $K^\pm$, p AND $\bar{p}$ ON PROTONS AND DEUTERONS BETWEEN 50 AND 200 GeV/c. Carroll, A. S.; Chiang, I.; Kycia, T. F. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 24p. (CONF-740713-32). Dep. NTIS $4.25.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

Total cross sections of $\pi^\pm$, $K^\pm$, p and $\bar{p}$ on protons and deuterons were measured to a high precision at 50, 100, 150 and 200 GeV/c. The antiproton cross sections decrease with increasing momentum from 50 to 150 GeV/c but between 150 and 200 GeV/c there is very little variation. The cross sections of the other particles are observed to rise with increasing momentum. (auth)

4581 (BNL-19236) CHARACTERISTICS OF THE MULTI-PARTICLE FINAL STATES ASSOCIATED WITH A LARGE TRANSVERSE MOMENTUM PROTON IN 28.5 GeV/c pp INTERACTIONS. Anderson, E. W.; Clifford, T. C.; Collins, G. B.; Ficenec, J. R.; Gutay, L. J.; Lazarus, E.; Schreiner, W. N.; Schuebelin, P.; Stringfellow, B. C.; Turkot, F. (Purdue Univ., Lafayette, Ind. (USA); Virginia Polytechnic Inst. and State Univ., Blacksburg (USA); Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 29p. (CONF-740713-31). Dep. NTIS $4.50.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

A sharp rise (~15%) was reported in the mean charged-particle multiplicity associated with a fast forward proton in pp collisions at 28.5 GeV/c. This rise occurs for a fixed missing mass when the four momentum transfer, t, of the proton is ~2.5 $(GeV/c)^2$. Distributions of the final state particles are presented as a function of t in the range from 0.1 to 7.0 $(GeV/c)^2$ corresponding to transverse momentum from 0.3 to 2.3 GeV/c. These data are consistent with a simple exchange model having the properties: at large t there is one elastic vertex and at small t the charged multiplicity is reduced by π^0 bremsstrahlung from the elastic vertex. (auth)

4582 (COO-1428-393) PROPOSAL TO SURVEY CENTRAL COLLISIONS IN THE REACTION $\bar{p} + p \rightarrow$ MESONS BETWEEN 30 AND 60 GeV/c IN THE 30'' HYDROGEN BUBBLE CHAMBER AT N.A.L. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Physics). 1 Oct 1974. Contract AT(11-1)-1428. 10p. Dep. NTIS $4.00.

It is proposed to carry out a detailed survey of antiproton interactions with particular emphasis on the annihilation process. Annihilation interactions could give an insight into the behavior of hadrons at small distances and shed light on the detailed structure of the nucleon. This physics may well be closely related to the high $p_\perp$ phenomena and to the recent results on e^+e^- annihilation both of which have exhibited unexpected features which may indicate a common underlying structure. This study of central collisions is ideally suited to the bubble chamber since the cross section is high and the interactions are dominated by high multiplicities. The choice of beam momentum is such that $\sqrt{s}$ ($\sqrt{s}$ = 7.9 GeV) centers on the energy range of SPEAR; and such that the annihilation cross section is large enough to be accessible to bubble chamber study. (auth)

4583 (COO-2232A-1) PROTON—DEUTERON ELASTIC SCATTERING AND DIFFRACTION DISSOCIATION FROM 50 TO 400 GeV. Akimov, Y.; Malamud, E.; Cool, R. (National Accelerator Lab., Batavia, Ill. (USA)). 1974. 27p. (CONF-740713-29; COO-3065-87; UR-494; NAL-CONF-74/56-EXP). Dep. NTIS $4.50.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

The coherent, low four-momentum transfer interaction of high energy protons with a deuterium gas jet target $p + d \rightarrow X + d$ at 50 to 400 GeV are studied. The differential cross sections are presented. (JFP)

4584 (COO—3023-18) HIGH ENERGY PHYSICS PROGRESS REPORT. (Tufts Univ., Medford, Mass. (USA)). Sep 1974. Contract AT(11-1)-3023. 26p. Dep. NTIS $4.50.

During the past year, the work of the bubble chamber group was concentrated on a variety of experiments in film from three exposures: 2.9 GeV/c K^-d from BNL, 2.2 GeV/c K^- on heavy liquid from Rutherford Laboratory, and 6.5 GeV/c K^-p from Argonne. In addition, considerable effort has gone into the development of proposals which were submitted to FNAL and BNL. These are the study of multiple particle production using hadrons on neon at FNAL, ν-d interactions in the 15 ft. chamber at FNAL, and multiple particle production using 25 GeV/c π^+p in the BNL 80-inch chamber with track-sensitive target. In the technical area the on-line measuring system was improved, and the scanning machines upgraded so that they can handle film from the Argonne 12-foot bubble chamber. (auth)

4585 (ISN-T-74-01) SYSTEMATIC STUDY OF ELASTIC AND INELASTIC SCATTERING OF 29 MeV POLARIZED DEUTERONS ON EVEN—EVEN NUCLEI. Perrin, G. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Apr 1974. 85p. (In French). Dep. NTIS (US Sales Only) $7.25.

Thesis.

Angular distributions of the differential cross section and of the vector and tensor analyzing powers were measured for the elastic scattering of 29-MeV vector and tensor polarized deuterons from ^{12}C, ^{28}Si, ^{40}Ca, ^{56}Fe, ^{58}Ni, ^{64}Zn, ^{90}Zr, ^{116}Sn, ^{120}Sn, and ^{208}Pb. The data could be fitted satisfactorily by optical model calculations using a l.s potential. Nevertheless, the inclusion of a T_R tensor potential was necessary to explain the experimental values of the tensor quantity $T_{22}-\sqrt{3/2}T_{20}$. An average optical potential dependent on the mass A and the charge Z was deduced. Cross sections and vector analyzing powers were also measured for the inelastic scattering from the first 2^+ and/or 3^- excited states. The coupled-channel calculations in the framework of the collective model gave an acceptable description of the data. The coupled-channel treatment revealed a strong dependence of the predicted elastic and inelastic analyzing powers on the mode of excitation and on the magnitude of the deformation parameter. (auth)

4586 (JINR-D-6004, pp 8-24) TOTAL CROSS SECTION OF THE INTERACTION OF $\pi^\pm$ AND K^+ MESONS AND PROTONS WITH PROTONS AND DEUTERONS IN THE REGION OF MOMENTA FROM 15 TO 60 GeV/c. Gorin, Yu. P. (Inst. of High Energy Physics, Serpukhov, USSR); Denisov, S. P.; Donskov, S. V.; Petrukhin, A. I.; Prokoshkin, Yu. D.; Stoyanova, D. A.; Allabi, D. V.; Dzhakomelli, D. 1972. (In Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4587 (JINR-D-6004), pp 50-84) ELASTIC pp AND pd SCATTERING IN THE SMALL ANGLE REGION. Zolin, L. S.; Nikitin, V. A.; Sviridov, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4588 (JINR-D-6004, pp 117-136) ELASTIC PROTON—NEUTRON SCATTERING BY MEANS OF PROTON—DEUTERON SCATTERING AT 24.0 GeV/c. Amaldi, U. (Istituto Superiore di Sanita, Rome); Biancastelli, R.; Bosio, C. 1972.

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

Measurements of proton-deuteron scattering were performed using an incident 24.0 GeV/c proton beam. Momentum-loss spectra of forward-scattered protons were measured by a single-arm spectrometer over a range of proton angles from 13.5 to 107.0 mr. The contributions to the proton spectra of single and double scattering can be separated experimentally, thus allowing estimates of proton-neutron elastic cross sections to be deduced from the data over a range of four-momentum transfer squared, $|t|$, from 0.1 to 5.8 GeV^2. Coincidence measurements of elastic p-d scattering over a range of $|t|$ from 0.6 to 1.8 GeV^2 are also reported. (auth)

4589 (JINR-D-6004, pp 137-191) REVIEW OF NEW RESULTS ON POLARIZATION IN HIGH ENERGY HADRON SCATTERING. van Rossum, L. (CEN, Saclay, France). 1972.

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

This review covers mostly data and comments that have been published since the Kiev Conference of last year. Even within this limit it does not attempt to be complete. The presentation of some of the recent experiments, and of their present interpretation, will give the opportunity, however, to comment on a few topics of particular interest. (auth)

4590 (JINR-D-6004, pp 307-323) COMPARISON OF MOMENTUM SPECTRA OF SECONDARY PARTICLES PRODUCED IN 14.25, 19.2, AND 24.0 GeV/c p–p COLLISIONS. Allaby, J. V.; Diddens, A. N.; Dobinson, R. W. (CERN, Geneva). 1972.

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

Results are reported of a measurement of π^+, π^- and p yields in pp collisions at 14.25, 19.2 and 24.0 GeV/c for secondary momenta above 4 GeV/c and laboratory angles between 10.5 and 25 mrad. The data provide further information on scaling and the approach to limiting distributions in the 10 to 30 GeV energy range. Structure, which was observed in the π^+ momentum spectrum, is discussed. (auth)

4591 (JINR-D1,2-7781, pp 164-172) SEARCH FOR NEW HEAVY PARTICLES IN P-NUCLEUS COLLISIONS AT PROTON ENERGY OF 70 GeV. Poze, D. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From third international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

4592 (JINR-D1,2-7781, pp 256-262) MULTIPLICITY OF NEUTRAL PIONS IN HIGH ENERGY COLLISIONS. Zieminski, A. (Univ. of Warsaw). 1974.

From third international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

The discussion of the multiplicity of neutral pions in high energy collisions covers π^0 multiplicity in π^+p interactions at 16 GeV/c, a model involving the isospin independence hypothesis for the multiplicity of neutral pions produced in high energy πp and pp interactions. (JFP)

4593 (JINR-D1,2-7781, pp 300-307) EVIDENCE FOR A STRUCTURE IN ($d\sigma/dt$) FOR $\bar{p}p \rightarrow \Delta^{++}\Delta^{++}$. Boehm, J. (Inst. of Physics, Prague); Cvach, J.; Jires, M.; Sedlak, J.; Simak, V.; Zacek, J.; Atherton, H. W.; French, B. R.; Skura, J. 1974.

From third international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

The differential cross sections and decay angular distributions are studied for the reaction $\bar{p}p \rightarrow \Delta^{++}$ (1236) + Δ^{++} (1236) in the reaction $\bar{p}p \rightarrow \bar{p}p\,\pi^+\pi^-$ at 5.68 GeV/c in a bubble chamber were studied. The t dependence of the 12 statistical tensors for the isobar decay in this reaction is found. (JFP)

4594 (JINR-D1,2-7781, pp 308-315) PRELIMINARY RESULTS ON THE REACTION $\bar{p}p \rightarrow 2\pi^+ 2\pi^-$ AT 5.7 GeV/c. Boehm, J. (Inst. of Physics, Prague); Covach, J.; Jires, M.; Sedlak, J.; Simak, V.; Zacek, J.; Atherton, H. W.; French, B. R.; Skura, J. 1974.

From third international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

Total cross sections and various distributions for the interaction $\bar{p}p \rightarrow 2\pi^+ 2\pi^-$ at 5.7 GeV/c are given a preliminary study. The single particle distributions show peripheral features of annihilation. An attempt is made to use the LPS analysis for the subtraction of resonances. The angular distribution for $\pi^+\pi^-$ combinations in the ρ^0 region indicates peripheral production of ρ^0 resonances. The distribution of t for $\pi^+\pi^-$ neutral combinations follows roughly the exponential line. (JFP)

4595 (JINR-D1,2-7781, pp 425-431) REACTION $d\mu + d \rightarrow dd\mu \rightarrow {}^3He + n + \mu$ IN GASEOUS DEUTERIUM. Bystritskii, V. M.; Dzhelepov, V. P.; Oganesyan, K. O.; Omel'yanenko, M. N.; Porokhovoi, S. Yu.; Rudenko, A. I.; Fil'chenkov, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From third international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

4596 (KFK-1977) NEUTRON–PROTON-CHARGE EXCHANGE SCATTERING FROM 8 TO 23 GeV/c. Pack, K. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Jul 1974. 50p. (In German). Dep. NTIS (US Sales Only) $5.50.

Thesis.

The neutron-proton-charge exchange reaction was investigated with a two arm method allowing both scattered particles to be detected. After subtraction of the background 28300 elastic events are obtained with incident momenta between 8 and 23 GeV/c. The t-dependence of the cross sections is found to be the same for all incident momentum bins within the errors. A fit of the two-exponential $e^{\alpha t} + \beta e^{\gamma t}$ to the measured cross sections yields for the parameters: $\alpha = (46 \pm 7)\ (GeV/c)^{-2}$, $\beta = 0.38 \pm 0.05$, $\gamma = (3.9 \pm 0.7)\ (GeV/c)^{-2}$. (auth)

4597 (LBL-58) $\bar{N}N$ AND ND INTERACTIONS: A COMPILATION. Enstrom, J. E.; Ferbel, T.; Slattery, P. F.; Werner, B. L.; Guiragossian, Z. G. T.; Sumi, Y.; Yoshida, T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Rochester Univ., N. Y. (USA); Stanford Univ., Calif. (USA). High-Energy Physics Lab.; Hiroshima Univ. (Japan); Fukushima Univ. (Japan). Faculty of Education). May 1972. 277p. Dep. NTIS $17.00.

There were 181 papers compiled reporting $\bar{p}p$, $\bar{p}n$, $\bar{p}d$, $\bar{n}p$, $\bar{n}n$, and $\bar{n}d$ reactions in flight for beam momenta up to 50 GeV/c. As a function of incident momentum, total and channel cross sections, elastic and two-body inelastic differential cross sections, and polarization in elastic scattering, as well as fits to the elastic differential cross sections are displayed. Also indices to the papers, as well as a complete listing of the selected data are provided. The approximate cutoff data for the literature search for this report was September 1, 1971. (auth)

4598 (UCR-34-P107B-170) HIGH ENERGY PHYSICS ANNUAL REPORT. Kernan, A.; Poe, R. T. (California Univ., Riverside (USA)). May 1974. Contract AT(04-3)-34. 17p. Dep. NTIS $4.00.

Experimental research on strong interactions is summarized. A list of publications is included. (JFP)

4599 PRODUCTION OF DEUTERONS IN INTERACTIONS OF 24 GeV/c PROTONS WITH Ag AND Br NUCLEI. Zafar, M.; Irfan, M.; Lal, K. B.; Ansari, A. R.; Shafi, M. (Aligarh Muslim Univ., India). Nuovo Cim.; 24A: No. 1, 111-119(1 Nov 1974).

The production mechanism of deuterons in high energy proton interactions with heavy nuclei was investigated. The characteristics of deuterons and protons such as the frequencies of emission, the angular and momentum distributions were given. The analysis of the experimental results suggests that at least two distinct processes are operating in the formation of deuterons of energies ~(40 to 700) MeV. (auth)

4600 PRODUCTION MECHANISMS AT LARGE TRANSVERSE MOMENTUM IN pp → $pp\pi^+\pi^-$ AT 28.5 GeV/c. Anderson, E. W.; Ficenec, J. R.; Gilbert, D. R.; Gutay, L. J.; Laasanen, A.; Ramanauskas, A.; Schuebelin, P.; Turkot, F. (Brookhaven National Lab, Upton, NY). Lett. Nuovo Cim.; 11: No. 10, 491-497(9 Nov 1974).

It was previously indicated that the short- and long-range (reggeon and pomeron) exchanges are intertwined in a double peripheral graph. In order to investigate this problem, four-constraint four-body final states of $pp \rightarrow pp\pi^+\pi^-$ reactions at 28.5 GeV/c at large transverse momentum (~ 1 GeV/c), a region heretofore unexplored, were studied. A low mass Δ^{++} enhancement, probably the N(1688) at large transverse momentum was isolated. A sample of events was found in which the large transverse momentum of the proton is balanced by a single meson. And a strong indication for the isoscalar dominance of the pomeron-nucleon t-channel amplitude at large transverse momentum was observed. (JFP)

4601 HADRON PRODUCTION IN PROTON–PROTON INTERACTIONS AT 102 AND 405 GeV/c. Bromberg, C. M. Rochester, NY; Univ. of Rochester (1974). 117p. University Microfilms Order No. 74-22,563.

Thesis (Ph. D.).

Utilizing exposures of the ANL/NAL 30-inch hydrogen-filled bubble chamber, the characteristics of inclusive particle production at 102 and 405 GeV/c were investigated. A two-component description, which characterizes the events as either diffractive or multiperipheral in nature, is in good agreement with the data. A comparison of the multiplicity distributions at 102 and 405 GeV/c with similar data in this energy range indicate an approximate ln s growth of the mean multiplicity ($\langle n \rangle$) and a $\ln^2 s$ growth of the second Mueller moment (f_2^-) of the negative-particle multiplicity distribution. Two-component descriptions are shown to provide a reasonable framework which can reproduce the latter behavior. (Diss. Abstr. Int., B)

4602 NEW VALUE FOR THE MAGNETIC MOMENT OF THE ANTIPROTON. Roberts, B.L.; Cox, C.R.; Eckhause, M.; Kane, J.R.; Welsh, R.E. (College of William and Mary, Williamsburg, Virginia 23185); Jenkins, D.A.; Lam, W.C.; Barnes, P.D.; Eisenstein, R.A.; Miller, J.; Sutton, R.B.; Kunselman, A.R.; Powers, R.J.; Fox, J.D. Phys. Rev. Lett. 33: No. 19, 1181-1182 (4 Nov 1974).

From a study of the fine–structure splittings in antiprotonic atoms formed in Pb and U, we have obtained a precise value of the $\bar{p}$ magnetic moment: $\mu_{\bar{p}} = (-2.819 \pm 0.056)\,\mu_N$. (auth)

4603 STUDY OF THE REACTION $\bar{p}n \rightarrow \bar{p}p\pi^-$ —Pπ AT 14.6 GeV/c. Brucker, E.B.; Koller, E.L.; Raths, O.; Taylor, S. (Stevens Institute of Technology, Hoboken, New Jersey 07030); Stamer, P.E.;

Handler, T.; Plano, R.J.; Preissner, H.; Watts, T.L.; Grauman, J.U.; Fridman, A.; Gerber, J.; Michalon–Mentzer, M.E.; Schiby, R.; Voltolini, C. Phys. Rev. D 10: No. 5, 1373-1378 (1 Sept 1974).

From a 98000–photograph exposure of the BNL 80–in. deuterium–filled chamber to a 14.6–GeV/c $\bar{p}$ beam we have extracted those events that fit the channel $\bar{p}n \rightarrow \bar{p}p\pi^-$. The cross section for this channel is measured to be 730 ± 50 μb. The cross section for the reaction $\bar{p}n \rightarrow \bar{\Delta}^{--}(1238)p$ is determined to be 130 ± 30 μb. Evidence for target dissociation is presented. A comparison with the reaction $\pi^-n \rightarrow \pi^-p\pi^-$ at the same energy indicates agreement with factorization. (auth)

4604 HYPERFRAGMENTS AND DOUBLE Λ HYPERFRAGMENTS PRODUCED FROM Ξ^- CAPTURES. Goel, S. P. (Kurukshetra Univ., India); Prakash, Y. Indian J. Pure App. Phys.; 12: No. 3, 213-219(Mar 1974).

The capture at rest of Ξ^- hyperons in emulsion nuclei is simulated, and the characteristics of hyperfragments and double Λ hyperfragments produced from such captures are studied. (auth)

Strong (Meson-induced)

4605 (COO-1195-290) ANALYSIS OF THE REACTION $K^-p \rightarrow K^-\pi^-\pi^+p$ AT 40 GeV/c. Antipov, Yu. M.; Ascoli, G.; Busnello, R. (Illinois Univ., Urbana (USA); Gosudrastvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij; European Organization for Nuclear Research, Geneva (Switzerland)). Sep 1974. Contract AT(11-1)-1195. 39p. Dep. NTIS $5.00.

The reaction $K^-p \rightarrow K^-\pi^-\pi^+p$ was measured at 25 and 40 GeV/c at the Serpukhov Proton Accelerator. The production cross section at 25 and 40 GeV/c as a function of momentum transfer and $K\pi\pi$ mass is presented, and results of the partial wave analysis of the $K\pi\pi$ system yielding information about Q(1300)-, K*(1400)- and L(1770)-mesons are discussed. (auth)

4606 (COO-1428-392) PROPOSAL TO MEASURE THE DIFFERENTIAL CROSS SECTION FOR SEVERAL BARYON EXCHANGE REACTIONS. Dixon, R. L.; Finley, D. A.; Fletcher, J. M.; Garfinkel, A. F.; Loeffler, F. J.; Mudrak, S.; Shibata, E. I.; Stanfield, K. C.; Hoffman, E. W. (Purdue Univ., Lafayette, Ind. (USA); Argonne National Lab., Ill. (USA)). Aug 1974. Contract AT(11-1)-1428. 23p. Dep. NTIS $4.25.

It is proposed to measure the differential cross sections for several backward (u-channel) reactions of the type $\pi^-p \rightarrow X^-\pi^+$ ($X^- = \Delta^-(1236),\ldots$) and $K^-p \rightarrow Y^-\pi^+$ ($Y^- = \Sigma^-, Y^{*-}(1385),\ldots$) in the u-range $0 \gtrsim u \gtrsim -0.7$ (GeV)^2 at 5.0 GeV/c. Data for these reactions are scarce or nonexistent. It is proposed to gather high statistics data which will make possible meaningful tests of SU(3) and Regge model predictions for the reactions: $K^-p \rightarrow \Sigma^-\pi^+$, $K^-p \rightarrow Y^{*-}(1385)\pi^+$, and $\pi^-p \rightarrow \Delta^-(1236)\pi^+$. The experiment proposed is a continuation of studies of backward reactions begun in E-348, in which the differential cross sections for reactions of the type $\pi^-p \rightarrow X^+\pi^-$ ($X^+ = p, \Delta^+(1236),\ldots$) and $K^-p \rightarrow Y^+\pi^-$ ($Y^+ = \Sigma^+, Y^{*+}(1385),\ldots$) are measured. It is intended to use the present E-348 apparatus with only two changes: reversal of the polarity of the SCM-105 magnet used in the spectrometer in order to maximize the acceptance for positive recoil particles and addition of a time-of-flight system to the spectrometer to aid in the separation of recoil π^+'s from background protons. The 17° beam is used where intensities of 2.5×10^6 π^- and 20,000 K^- per pulse are presently available. The theoretical interest in the backward reactions $K^-p \rightarrow \Sigma^-\pi^+$, $K^-p \rightarrow Y^{*-}(1385)\pi^+$, and $\pi^-p \rightarrow \Delta^-(1236)\pi^+$ and the present experimental situation regarding these reactions is summarized. The expected counting rates are presented for the proposed experiment. A total of eighty shifts is requested for this experiment. (auth)

4607 (JINR–D-6004, pp 25-49) $K^0_L - K^0_S$ REGENERATION ON HYDROGEN AT HIGH ENERGIES. Birulev, V. K. (Joint Inst. for Nuclear Research, Dubna, USSR); Vovenko, A. S.; Vestergombi, D. 1972. (In Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4608 (JINR–D-6004, pp 192-233) EXPERIMENTAL STUDY OF ELASTIC πp AND Kp FORWARD SCATTERING AT HIGH ENERGIES. Nomofilov, A. A.; Sitnik, I. M.; Strunov, L. N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4609 (JINR–D-6004, pp 234-255) ELASTIC SCATTERING OF HADRONS AT HIGH MOMENTUM TRANSFERS. Orear, J. (Cornell Univ., Ithaca, NY). 1972.

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

A review is given of the present experimental situation in hadron-proton elastic scattering at momentum transfers $-t >$ 1 GeV^2. Cross sections and angular distributions are discussed. Also some future experiments are described. (JFP)

4610 (JINR–D-6004, pp 256-270) COMPARISON OF CROSSING SYMMETRIC $K^\pm p$, $p^\pm p$, $\pi^\pm p$ ELASTIC SCATTERING AND $\bar{p}p$ ANNIHILATION PROCESSES AT 5 GeV/c. Lundby, A. (CERN, Geneva). 1972.

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

Preliminary data on K^+p, K^-p, pp, π^-p, and $\bar{p}p$ interactions at 5 GeV/c are discussed. Angular distributions and cross sections are considered. (JFP)

4611 (JINR–D-6004, pp 324-362) TOTAL CROSS SECTION FOR THE INTERACTION OF HADRONS AT HIGH ENERGIES. Ammosov, V. V.; Savrin, V. I.; Tyurin, N. E. (Inst. of High Energy Physics, Serpukhov, USSR). 1972. (In Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4612 (JINR-D1,2-7781, pp 173-185) GENERATION OF $K^0_L - K^0_S$ ON DEUTERIUM. Berlin-Budapest-Dubna-Prague-Serpukhov-Sofia Collaboration. 1974. (In Russian).

From third international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

4613 (JINR-D1,2-7781, pp 186-202) REGENERATION OF NEUTRAL KAONS ON CARBON IN THE MOMENTUM REGION FROM 16 TO 40 GeV/c. Berlin-Budapest-Dubna-Prague-Serpukhov-Sofia Collaboration. 1974. (In Russian).

From third international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

4614 (JINR-D1,2-7781, pp 203-218) SEMI-INCLUSIVE REACTION IN FOUR-BEAM INTERACTIONS AT 5 GeV/c. Beshliu, K. (Univ. of Bucharest); Konstantinesku, A.; Kotorobai, F. 1974. (In Russian).

From third international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

4615 (JINR-D1,2-7781, pp 290-299) SOME RESULTS ON CORRELATIONS IN PARTICLE PRODUCTION IN PION–PROTON INTERACTIONS AT 40 GeV/c. Sabau, M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974.

From third international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

Some results of an investigation of correlation effects in π^-p interactions at 40 GeV/c are presented based on data from the 2m propane bubble chamber irradiated with π^- mesons at the Serpukhov accelerator are given. Results are given concerning the two-particle correlation function and the correlation length. (JFP)

4616 (JINR-D1,2-7781, pp 316-327) TOTAL CROSS SECTION FOR THE DOUBLE CHARGE EXCHANGE REACTION AT 100 MeV. Falomkin, I. V. (Joint Inst. for Nuclear Research, Dubna, USSR); Kulyukin, M. M.; Lyashenko, V. I.; Pontecorvo, G.; Shcherbakov, Yu. A.; Georgescu, C.; Mihul, A.; Nichitiu, F.; Sararu, A.; Piragino, G. 1974.

From third international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

An analysis of the possibility of observing the double charge exchange of pions on the helium-4 nucleus using the high pressure helium streamer chamber technique is given. In this experiment a streamer chamber without a magnetic field was used, and therefore the total cross section was measured only for the reaction $\pi^+ + {}^4He \rightarrow \pi^- + 4p$ in which all secondary particles were charged and could be detected in the chamber. (JFP)

4617 (JINR-D1,2-7781, pp 337-345) TEST FOR THE X^0(960) SPIN. Genina, L. E.; Lednicky, R.; Zaslavsky, A. N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974.

From third international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

Correlations between decay and production of the X^0(960) meson which permit one to distinguish the hypotheses $J^P(X^0) = 2^-$ and 0^- are discussed. The most sensitive correlations to the X^0-meson spin were found. In case of the most unfavorable spin density matrix ~500 events for the annihilation $\bar{p}p \rightarrow \rho^0X^0$ at rest and ~150 events of the forward X^0-meson production in the reaction $K^-p \rightarrow X^0\Lambda$ are needed. These numbers are the maximum estimates for the number of events needed to resolve X^0-meson spin alternative. In the real case, especially for the antiproton-proton annihilation at rest, the number of events needed is probably much less. (auth)

4618 (JINR-P1-8147) CROSS SECTIONS OF STRANGE PARTICLES PRODUCED IN π^-p INTERACTIONS AT 5 GeV/c. Glagolev, V. V.; Dushutin, N. K.; Kladnitskaya, E. N.; Kuznetsov, A. A.; Lebedev, R. M.; Mal'tsev, V. M.; Pestova, G. D.; Popova, V. M.; Sabeu, M.; Saitov, I. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Results are presented on π^-p interactions with strange particle production in the I m hydrogen bubble chamber of the JINR[2] at $P_{\pi^-} = (4.9 \pm 0.05)$ GeV/c. The selection of events and data handling are given elsewhere. The determined values of the cross sections in millibarns are: Total cross section for strange particle production in π^-p interactions at 4.9 GeV/c is $\sigma_{tot} = 3.3 \pm 0.1$ mb. Cross sections for pairs of strange particles $\sigma_{\gamma^0 k^0} = 0.52 \pm 0.02$; $\sigma_{\gamma^0 k^+} = 0.32 \pm 0.02$; $\sigma_{k_1^0 k_1^0} = 0.12 \pm 0.01$; $\sigma_{k^0 k^-} = 0.24 \pm 0.02$; $\sigma_{k^0 k^+} = 0.16 \pm 0.02$; $\sigma_{k^0\Sigma^+} = 0.062 \pm 0.007$; $\sigma_{k^0\Sigma^-} = 0.084 \pm 0.006$; $\sigma_{k^+k^-} = 1.30 \pm 0.15$; $\sigma_{k^+\Sigma^-} = 0.073 \pm 0.007$; $\sigma_{k^+\Sigma^+} = 0.023 \pm 0.004$. Inclusive cross sections $\sigma_{\gamma^0} = 0.85 \pm 0.03$; $\sigma_{k^0(\bar{k}^0)} = 1.65 \pm 0.05$; $\sigma_{\Sigma^+} = 0.078 \pm 0.008$; $\sigma_{\Sigma^-} = 0.150 \pm 0.009$; $\sigma_{k^+} = 1.98 \pm 0.18$, $\sigma_{k^-} = 1.76 \pm 0.16$. Topological cross sections $\sigma_0 = 0.38 \pm 0.02$; $\sigma_2 = 1.84 \pm 0.05$; $\sigma_4 = 1.02 \pm 0.05$; $\sigma_6 = 0.058 \pm 0.009$; $\sigma_8 = 0.003 \pm 0.002$. The cross sections of reaction channels are shown in Table IV. The average charged multiplicity in π^-p interactions at 4.9 GeV/c is $\langle n_\pm \rangle = 2.86 \pm 0.04$, and the value for π^-p interactions with strange particle production is $\langle n_\pm \rangle = 2.46 \pm 0.11$. The average multiplicity of different strange particles produced is $\langle n_{\gamma^0} \rangle = 0.037 \pm 0.001$, $\langle n_{k^0(\bar{k}^0)} \rangle = 0.072 \pm 0.002$, $\langle n_{\Sigma^0} \rangle = 0.010 \pm 0.0005$, $\langle n_{k^+} \rangle = 0.087 \pm 0.008$, $\langle n_{k^-} \rangle = 0.076 \pm 0.007$. In order to obtain information about the mechanism of interaction, some sum rules were checked using the determined cross sections. Such a test shows that strange particles are produced by different mechanisms and not by a single one. Therefore, these sum rules and those which take into account a large contribution of diffractive processes are not fulfilled. An agreement was obtained for the sum rules for n = 4. The basic assumption for these sum rules was that uncorrelated two-particle and multiparticle resonances were produced. (auth)

4619 (ORO-2504-100(Suppls.)) TVGP SQUAW OPERATIONAL INFORMATION. 1967–1973 Supplements A to S. Technical Report No. 649. Day, T. B. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Aug 1974. 95p. Dep. NTIS $7.75.

Changes to TVGP in SQUAW made at Maryland from 1967 to 1973 are described. They were collected into one bank for ease of distribution. They are supplements A to S to AEC-ORO-2504-100, TVGP operational information. (auth)

4620 PRODUCTION OF π^0 MESONS IN K^+p INTERACTIONS AT 8.2 GeV/c. Bartke, J. (Inst. of Nuclear Physics, Krakow); Eskreys, A.; Figiel, J.; Malecki, P.; Zalewski, K.; Zorska, J. Acta Phys. Pol.; 5B: No. 5, 689-693(1974).

Experimental results on π^0 production in K^+p interactions at 8.2 GeV/c incident momentum are presented. Average π^0 multiplicities for given prong numbers are evaluated. They are consistent both with the corresponding results for pp interactions at 12 GeV/c (chosen for comparison because they have the same average prong number) and with a model where total multiplicity distributions are calculated from the Czyzewski–Rybicki formula and the charge branching ratios from the statistical model. Some averages over the π^0 momentum distribution are also evaluated. In particular it is found that π^0-s produced in two prong interactions goes predominantly forward. (auth)

4621 STUDY OF $\pi\pi$ CROSS SECTION DETERMINATION BY EXTRAPOLATION METHODS, IN THE REACTION $\pi^-p \to \pi\pi N$ AT 4.43 GeV/c. Jacques, P. F. Philadelphia; Univ. of Pennsylvania (1974). 188p. University Microfilms Order No. 74-22,857.

Thesis (Ph. D.).

The analysis of 13,252 events of the type $\pi^-p \to \pi^-\pi^+n$ and 8,060 events of the type $\pi^-p \to \pi^-\pi^0p$ is presented. These represent all of the single pion production events obtained from an exposure of the SLAC 82 inch hydrogen bubble chamber to a π^- beam at 4.43 GeV/c which yielded 111,513 successfully reconstructed two prong events. The single pion production events are used to study the total cross section for the reactions $\pi^-\pi^+ \to \pi^-\pi^+$ and $\pi^-\pi^0 \to \pi^-\pi^0$, via an extrapolation to the pion pole. Results are presented of cross section extrapolations made using the basic Chew-Low procedure both with and without the OPE constraint on $d\sigma/d\Delta^2$ at $\Delta^2 = 0$, as well as of extrapolations modified by conformal mapping, form factors, and absorption effects. The various extrapolations are compared on the basis of agreement with the unitarity limit at the ρ mass χ^2 goodness of fit and sensitivity to changes in the Δ^2 interval used. In the $\pi^-\pi^+$ channel an extrapolation using the conformal mapping, without the OPE constraint, is favored among the model independent extrapolations. The use of form factors also produces a reasonable result, whereas an extrapolation using the absorption model fails to reach the unitarity limit at the ρ mass. Extrapolation in the $\pi^-\pi^0$ channel was greatly hampered by the scanning bias against low momentum transfer events and only extrapolations made with the OPE constraint on $d\sigma/d\Delta^2$ gave sensible results. The density matrix elements for the $\pi^-\pi^+$ events are also determined from the data and are found to be in agreement with the predictions of the P. K. Williams absorption model. Both the $\pi^-\pi^+$ events and the $\pi^-\pi^0$ events are shown to contain significant contributions from channels other than single pion exchange by application of the Treiman-Yang test and by study of the spherical moments of their decay angular distributions. (Diss. Abstr. Int., B)

4622 MULTISTEP EXCITATION IN COHERENT NUCLEAR PRODUCTION PROCESSES. Faeldt, G.; Osland, P. Ark. Fys. Seminar Trondheim; No. 8, 1-15(1974).

Data from measurements at CERN using a 15-GeV pion beam giving the reactions $\pi A \to (3\pi)A$ and $\pi A(5\pi)A$ for a large number of nuclei, were analyzed in detail, assuming that the 3π-nucleon cross section is equal to the pion-nucleon cross section. Attention is drawn to a very clean method of observing directly the presence of two-step contributions, consisting of measuring the angular distribution for coherent A_3 production at low energies (3 to 5 GeV) on helium and deuterium targets. (JIW)

4623 ASYMPTOTIC BEHAVIOR OF CROSS SECTIONS OF LEPTON PRODUCTION OF SCALAR MESONS. Gakh, F. I.; Pyzh, V. M. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 7, 1074-1092(Jul 1974). (In Russian).

Differential cross sections are calculated for the simplest reactions of lepton production of hypothetic heavy scalar mesons. Two first terms of asymptotic decompositions of the total cross sections of these reactions of the point target are obtained. (auth)

4624 INVESTIGATION OF ρ–MESON PRODUCTION IN πp INTERACTIONS AT 3.9 GeV/c. Haber, B.; Hodous, M.F.; Hulsizer, R.I.; Kistiakowsky, V.; Levy, A.; Pless, I.A.; Singer, R.A.; Wolfson, J.; Yamamoto, R.K. (Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 10: No. 5, 1387-1401 (1 Sept 1974).

We have investigated the ρ–meson production mechanism in the three reactions $\pi^+p \to \rho^+p$ and $\pi^-p \to \rho^0n$ at 3.9 GeV/c ($s = 8.2$ GeV^2) using the prism–plot technique. Differential cross sections at all momentum transfers are presented. A significant backward peak has been found in all three reactions. The differential cross sections for these backward peaks are given and are compared with the equivalent pion elastic and charge–exchange cross sections in the backward direction. Using a linear combination of the three differential cross sections we have isolated the $I = 0$ exchange contribution in the forward direction. This differential cross section has a zero at $-t = 0.45$ (GeV/c)^2 and is fitted by the dual absorptive model of Harari with an interaction radius of ~ 1.2 F. The total $I = 0$ cross section is calculated and compared with similarly determined cross sections at higher momenta. An analysis of the properties of the other possible spin–parity exchanges is also presented. (auth)

4625 PRODUCTION AND DECAY OF Σ (1660). Apsell, S.P.; Ford, P.; Gourevitch, S.; Kirsch, L.E.; Schmidt, P.E. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154); Chang, C.Y.; Stottlemyer, A.R.; Yodh, G.B.; Glickman, S.; Goldberg, M.; Jacobs, S.M.; Meadows, B.; Moneti, G.C.; Brenner, J.; Schneps, J.; Wolsky, G. Phys. Rev. D 10: No. 5, 1419-1429 (1 Sept 1974).

An investigation has been performed of some properties of Σ (1660) produced in the reaction $K^-p \to \Sigma^+(1660)\,\pi^-$ at 2.87 GeV/c incident K^- momentum. The decay modes observed for this state include Λ (1405) π and Σπ. The spin and parity are measured to be $j^P = 3^-/2$. The differential cross section of the Λ (1405) π decay mode is sharply peaked in the forward direction, falling exponentially with a slope of 5.6±0.7 (GeV/c)$^{-2}$, while the slope for the $\Sigma^0\pi^+$ decay mode is 2.1±0.4 (GeV/c)$^{-2}$. The difference in the ratio of backward to total events for the two decay modes also suggests that two (1660)'s exist. (auth)

4626 $\pi - \pi$ SCATTERING AND π^+d INTERACTIONS AT 7 GeV/c. Carroll, J.T.; Matthews, J.A.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Walker, W.D.; Firebaugh, M.W.; Prentice, J.D.; Yoon, T.S. Phys. Rev. D 10: No. 5, 1430-1457 (1 Sept 1974).

Using bubble-chamber data on the reactions $\pi^+d \to p_s p\pi^0\pi^0$, $\pi^+d \to p_s p\pi^+\pi^-$, and $\pi^-p \to n\pi^+\pi^-$ at 7 GeV/c incident π momentum, $\pi-\pi$ phase shifts are determined for $0.6 < M(\pi\pi) < 1.5$ GeV/c^2. An $I = 0$ S–wave resonance is observed in the f^0 peak region of $M(\pi\pi)$. Constructive $\rho-\omega$ interference is found in the reaction $\pi^+n \to$

$p\pi^+\pi^-$ and evidence is presented for some specifically deuteron effects in the data with large spectator–proton momentum. (auth)

4627 COHERENT PRODUCTION REACTION $\pi^- + A \rightarrow \pi^- + \pi^0 + A$. Strawczynski, L. Rochester, NY; Univ. of Rochester (1974). 183p. University Microfilms Order No. 74-22,631.
Thesis (Ph. D.).

The final state $\pi^- + \pi^0$ produced by 22.7 GeV/c π^- incident on a variety of complex nuclear targets: C, Al, Cu, Ag, Pb and U was measured. The experiment was performed at the Brookhaven A.G.S. using the spectrometer facility of the Lindenbaum–Ozaki Group. Sharp peaks were observed in the t′ distribution of the events recorded using medium and heavy nuclei. This structure is localized to the range $|t'| < 0.02$ $(GeV/c)^2$ and consists of an almost pure ρ^- yield. The t′ shape and Z dependence of these data indicate the presence of two production amplitudes: ρ^- production in the nuclear Coulomb field (Primakoff effect) and ρ^- production in the nuclear surface via ω^0 exchange. The data were analyzed using a model of coherent production including the Coulomb and hadronic interactions and their interference. The parameters of the model are the radiative width $\Gamma(\rho^- \rightarrow \pi^-\gamma)$, C_{str} a measure of the strength of the ϕ-exchange process, and ϕ the relative phase of the two channels. These parameters are coupled, and a range of acceptable solutions is provided. The optical model satisfactorily reproduces the qualitative features of the data. An upper and lower bound are obtained for the radiative width $\Gamma(\rho^- \rightarrow \pi^-\gamma)$: $\Gamma_{min} < \Gamma(\rho^- \rightarrow \pi^-\gamma) < \Gamma_{max}$, $\Gamma_{min} = 30 \pm 10$ keV, and $\Gamma_{max} = 80 \pm 10$ keV. A value of $\Gamma(\rho^- \rightarrow \pi^-\gamma)$ to 10 keV uncertainty may be obtained if the relative phase, ϕ, is specified. The simple quark model predicts $\Gamma = 120$ keV. The measurement of C_{str} is in moderate agreement with hydrogen data at lower energies. (Diss. Abstr. Int., B)

4628 ENERGY AND ANGULAR SPECTRA OF PROTONS EMITTED IN π–Xe INTERACTIONS AT 3.5 GeV/c. Strugal'skii, Z. S.; Plyuta, Ya. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 3, 504-508(Sep 1974). (In Russian).

The results of the experimental study of the energy and angular spectra of protons emitted in the π–Xe interactions at 3.5 GeV/c are presented. The dependence of the spectra upon the number of π^+ mesons produced in the interactions is also given. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 4573 and 5004.

4629 (ANL/HEP-7442) REVIEW OF SOME ASPECTS OF MULTIPARTICLE PHYSICS IN THE "BULK LIMIT": INCLUSIVE AND SEMI-INCLUSIVE CORRELATIONS. Thomas, G. H. (Argonne National Lab., Ill. (USA)). 1974. 25p. (CONF-740713-27). Dep. NTIS $4.25.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

Emphasis is given in this review of multiparticle physics in the bulk limit to a two-particle correlation function, positive correlation of neutral with charged particles, and a charge transfer suggestive of local clustering, the inclusive multi-Regge explanations of the shape of correlation functions, and clustering in the statistical mechanics sense of cluster expansion. (JFP)

4630 (DESY-74/39) COMMENTS ON GENERALIZED VECTOR DOMINANCE. Schildknecht, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1974. 16p. (CONF-740713-30). Dep. NTIS (US Sales Only) $4.00.

From 17th international conference on high-energy physics; London, UK(1 Jul 1974).

Various problems with generalized vector dominance are discussed, then a recent attempt to formulate a model within the off-diagonal framework is briefly described. (JFP)

4631 (ITF-74-86P) MICROCAUSALITY BREAKING AND THE POMERANCHUK THEOREM. Lomsadze, Yu. M.; Sabad, E. P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The results of the previous work are generalized to the case when the Bogoliubov microcausality principle is broken by introduction of the finite elementary length l, conserving the relativistic invariance theory. Such a breaking is achieved at the cost of essential outcome of the class of tempered distributions. It is proven that in this case the Pomeranchuk generalized theorem is valid which in the limit $l \rightarrow 0$ changes into the usual Pomeranchuk theorem. (auth)

4632 (JINR–D-6004, pp 523-534) REGGE PARAMETERS AND THE PATTERN OF TOTAL CROSS SECTIONS IN THE REGION OF VERY HIGH ENERGIES. Ter-Martirosyan, K. A. (Inst. of Theoretical and Experimental Physics, Moscow). 1972. (In Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4633 (JINR-D1,2-7781) PROCEEDINGS OF THE III INTERNATIONAL SYMPOSIUM ON HIGH ENERGY AND ELEMENTARY PARTICLE PHYSICS, SINAIA, ROMANIA, OCTOBER 2–10, 1973. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 473p. (In Russian and English). (CONF-731088-). Joint Inst. of Nuclear Research, Dubna.

The conference included 36 papers, seven of which were previously abstracted in NSA as: 29:30720, 29:30719, 29:30825, 30:11017, 29:30851, 29:19373, and 29:13821. Separate abstracts were prepared for 29 papers. (JFP)

For abstracts of individual papers see: 4571, 4576, 4591–4595, 4612–4617, 4634–4636, 4653, 4654, 4693, 4694, 4716–4718, 4754, 4771–4773, 4793, and 4877.

4634 (JINR-D1,2-7781, pp 346-354) SOME FEATURES OF THE REACTIONS WITH N-PARTICLES (n > 4). Mihul, E. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974.

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

Two features of particle interactions are presented as altogether independent. The first is the analyticity properties of the five-particle amplitude near the physical region within the framework of local field theory. The second is a new kinematical variable, the determinant of the matrix formed with the components of the four-momenta. (JFP)

4635 (JINR-D1,2-7781, pp 355-359) SOME PROBLEMS RELATED TO QUANTUM-MECHANICAL DESCRIPTION OF DECAY AND COLLISION PROCESSES. Alda, V. (Mathematical Inst., Prague); Kundrat, V.; Lokajicek, M. V. 1974.

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

From the quantum mechanical description of decay and collision processes of particles, it is found that such processes can be well described within the framework of the nonunitary theory without having any problems with the experimental decay law. The given structure is also in agreement with experimental facts concerning the irreversible character of these processes. (JFP)

4636 (JINR-D1,2-7781, pp 432-443) ONE POSSIBILITY FOR THE CONSTRUCTION OF THE LOCAL COMMUTATORS IN CURRENT ALGEBRA. Fakirov, D. (Inst. of Nuclear Research and Nuclear Energy, Sofia). 1974. (In Russian).

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

4637 (JINR-P2-8155) PROCESSES OF MULTIPARTICLE PRODUCTION IN THE METHOD OF THE EXTENDED S-MATRIX. Sinegovskii, S. I.; Mal'tsev, V. M.; Dushutin, N. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

In the method of the extended S-matrix equations for multiparticle amplitudes were constructed. On this basis integral characteristics of multiparticle production of hadrons are considered. (auth)

4638 (PURC-4159-26) DIFFRACTIVE DISSOCIATION WITHIN MULTIPERIPHERAL DYNAMICS. Abarbanel, H. D. I.; Chew, G. F.; Goldberger, M. L.; Saunders, L. M. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). Mar 1971. Contract AT(30-1)-4159. 47p. Dep. NTIS $5.50.

The relation of diffractive dissociation to multiperipheral dynamics is explored within the framework of the ABFST model. After splitting the kernel of the integral equation into "resonance" and "Pomeranchuk" components, a variational technique is employed to treat the Pomeranchuk component as a small perturbation. The corresponding perturbed structure of the Fredholm determinant is developed in detail, leading to identification of a small dimensionless parameter η_P which measures the strength of the AFS branch point and thereby sets the scale of Regge fine structure near J = 1. It is shown that η_P also determines the probability of diffractive dissociation into large masses and thus is subject to experimental determination. (auth)

4639 (PURC-4159-28) LIGHT CONE STRUCTURE OF CURRENT COMMUTATORS IN THE GLUON-QUARK MODEL. Gross, D. J.; Treiman, S. B. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). 1971. Contract AT(30-1)-4159. 44p. Dep. NTIS $5.25.

The formal structure of current commutators near the light cone (currents separated by nearly light-like distances) is studied for quark models with interactions mediated by SU(3) × SU(3) singlet vector or scalar mesons. The idea in the end is to abstract the general structure features and to thereafter discard the specifics of the underlying model. The approach adopted is formal, in the sense that all manipulations are based on canonical equal time commutation relations and on the corresponding canonical equations of motion. The light cone commutator is expressed in terms of certain bilocal operators and has a definite tensor and SU(3) × SU(3) structure that forms the heart of the abstraction. The analysis is greatly facilitated by a theorem which shows that the gluons can be treated in the external field approximation for purposes of determining the leading light cone singularities. It is an important result that the tensor and SU(3) × SU(3) structure of the light cone commutator turns out to be the same for the gluon models as for the free quark model. The practical implications of this structure, already discussed by Gell-Mann, are therefore preserved in the gluon model. The applications are reviewed. Some of the delicacies connected with current conservation are discussed, and it is shown how to write the commutator in a form where current conservation is manifest. The structure of the vacuum matrix elements of the commutator is also discussed. Finally, the commutation relations among the bilocal operators are investigated, and it is shown that the algebra closes for bilocals defined in a single light-like ray. The various results are compared with those obtained by canonical light cone quantization procedures. (auth)

4640 (PURC-4159-41) SPIN DEPENDENCE IN INCLUSIVE REACTIONS. Abarbanel, H. D. I.; Gross, D. J. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). Jul 1971. Contract AT(30-1)-4159. 43p. Dep. NTIS $5.25.

The spin dependences of high energy inclusive reactions are treated from the viewpoint of a J-plane analysis. Measurements of various spin correlations are shown to bear directly on questions such as factorization of residua at Regge poles and the strengths of J-plane cuts. Examples of experiments are provided which test these ideas using polarized beams, polarized targets, or polarized products. Electroproduction and high energy neutrino reactions are viewed as sources for polarized spin-one "beams," and the implications for the processes are drawn in detail. Finally, scaling properties of these latter reactions are considered, and the produced particle multiplicity in the scaling region is discussed. (auth)

4641 (TID-26655) RESEARCH IN ELEMENTARY PARTICLE PHYSICS. Progress Report, September 1, 1972-April 30, 1973. Kirsch, L.; Schnitzer, H. J. (Brandeis Univ., Waltham, Mass. (USA). Dept. of Physics). 29 May 1973. Contract AT(11-1)-3230. 11p. Dep. NTIS $4.00.

A summary of research on the theoretical and experimental properties of elementary particles is given. A list of publications is included. (JFP)

4642 (TID-26662) HISTORY, DESCRIPTION, AND PLANS FOR EXPERIMENTAL AND THEORETICAL RESEARCH ACTIVITIES IN HIGH ENERGY PHYSICS. Volume II. Elementary Particle, Astro-Physics, Nuclear Physics. Progress Report. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). May 1973. Contract AT(11-1)-3071. 49p. Dep. NTIS $4.50.

Theoretical and experimental research in high energy physics is summarized. A list of publications is included. (JFP)

4643 OVERLAP FUNCTION FROM THE MULTIPERIPHERAL MODEL. Jadach, S. (Jagellonian Univ., Krakow); Turnau, J. Acta Phys. Pol.; 5B: No. 5, 677-688(1974).

Monte Carlo phase space calculations of the overlap function for Chan-Loskiewicz-Allison and Chew-Pignotti models were performed up to laboratory momentum 1500 GeV. The slope of the overlap function was found to be about four times smaller than the experimental value. Shrinkage of the elastic peak does not exceed the value found in experiment. The qualitative explanation of these results is given and the discrepancy with recent estimates obtained by Hamer and Peierls, Hwa, and Henyey is explained. Finally, it is argued that the random walk picture of the multiperipheral models is not valid for the realistic particle density in the rapidity scale. (auth)

4644 CURRENT COMMUTATORS IN THE HADRONIC VACUUM AND e^+e^- ANNIHILATION. Fritzsch, H. (California Institute of Technology, Pasadena, California 91109); Leutwyler, H. Phys. Rev. D 10: No. 5, 1624-1631 (1 Sept 1974).

We study the behavior of current commutators in the vacuum within the quark-gluon theory of strong interactions. Especially, the problem of $SU_3 \times SU_3$ symmetry breaking is considered. We derive spectral-function sum rules involving the bare-quark masses. Applications to vector-meson dominance, K_{l3} decay, and e^+e^- annihilation are discussed. (auth)

4645 THERMAL FLUCTUATIONS AND EXPERIMENTS ON THE FREE FALL OF ELECTRONS. Maris, H.J. (Physics Department, Brown University, Providence, Rhode Island 02912). Phys. Rev. Lett. 33: No. 19, 1177-1180 (4 Nov 1974).

In order to study the gravitational force on an electron Witteborn and Fairbank have measured the acceleration of electrons moving along the axis of a vertical copper tube. I show that in experiments of this type there are large corrections to the motion of the electrons due to thermal fluctuations in the electromagnetic fields in the tube. (auth)

4646 DILATATION INVARIANT BILOCAL QUANTUM THEORY FOR MASSIVE PARTICLES. Roman, P. (Boston Univ., MA). Rev. Mex. Fis.; 23: No. 1-2, 123-141(1974).

Within the framework of a previously developed algebraic approach to relativistic dilatation physics, bilocal wave equations for arbitrary spin are set up. The principal result of this study is that, despite dilatation invariance, particles can have nonzero rest mass. A canonical formalism is developed, and various currents are studied. (auth)

4647 EQUATIONS FOR SINGLE MASS. Loide, R. K. (Tallin Polytechnical Inst.). Izv. Akad. Nauk Est. SSR, Fiz. Mat.; 23: No. 3, 203-209(1974). (In Russian).

Equations without subsidiary conditions describing a single rest mass m are considered. Matrices β^0 and β^{∞} are written as a sum of operators $\beta^{(S_1)}$ containing spin projection operators for spin S_1. The structure of characteristic equations of $\beta^{(S_1)}$ is clarified. Projection operators which separate the solutions with mass m and spin S_1 are written out. (auth)

4648 RELATIONS BETWEEN TWO-PARTICLE CORRELATION COEFFICIENTS BASED ON ISOSPIN INVARIANCE AND CLUSTER-PRODUCTION MODELS. Test of These Models. Stern, J. (Univ., Louvain, Belg.). Ann. Soc. Sci. Brux. Ser. I; 88: No. 3, 313-325(1974).

It is argued that isospin invariance only is not sufficient to establish inequality relations between two two-particle correlation coefficients of differently charged pions and/or nucleons. An extra assumption has to be made on the production of these particles. They are assumed to be emitted exclusively or partially in pairs with or without definite isospin. A test is also made of these cluster-production models, and some of them are invalidated. (auth)

4649 SCALING OF MULTIPLICITY DISTRIBUTIONS AND STATISTICAL MECHANICS ANALOGY OF MULTIPARTICLE PRODUCTION. Uematsu, T. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 51: No. 3, 882-892(Mar 1974).

The KNO scaling of multiplicity distributions is interpreted in terms of the particle density in rapidity space. This interpretation motivates an exploitation of the analogy between multiparticle production and statistical mechanics in a one-dimensional system. The "pressure analog" is found to be useful in order to examine the KNO scaling in connection with the various classes of models for multiple production. It is shown that the "pressure" in the scaling case changes its shape from multiperipheral-like to diffraction-like as energy increases with particle density fixed. A phenomenological analysis on "pressure" is also given. (auth)

Electromagnetic

Refer also to abstracts 4196, 4797, 5082, 5105, and 5111.

4650 (EPIC-WP-1/19) PHYSICS WITH AN ELECTRON-POSITRON STORAGE RING OF BEAM ENERGY E = 14 GeV. Science Research Council, Chilton (UK). Rutherford Lab.). Jun 1974. 22p. (RL-74-098). Dep. NTIS (US Sales Only) $4.25.

The electron-positron system can be used to study a wide range of fundamental physical interactions. These are considered including hadron production in electron-positron annihilation, quantum electrodynamics, weak interaction effects, and nonannihilation production processes. (JFP)

4651 (ITF-74-78P) MESON FORM FACTORS POWER DECREASING IN RELATIVISTIC QUARK MODEL. Sinyukov, Yu. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Electromagnetic form factors for arbitrary spin mesons are studied in terms of relativistic oscillator quark model with Markoff-Yukawa conditions. The asymptotic power decrease of inelastic meson form factors is obtained. (auth)

4652 (JINR-D-6004, pp 582-632) BINARY HADRON PROCESSES WITH PARTICIPATION OF HIGH ENERGY PHOTONS. Matinyan, S. G. (Inst. of Physics, Erevan). 1972. (In Russian). Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4653 (JINR-D1,2-7781, pp 447-454) WHAT DO $e^+e^- \rightarrow \pi^+\pi^-$ AND $e^-p \rightarrow e^-\pi^+ n$ DATA TELL ABOUT THE PION FORM FACTOR. Raszillier, I. (Inst. of Physics, Bucharest). 1974.

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

From the discussion of the pion form factor as determined from the reactions $e^+ + e^- \rightarrow \pi^+ + \pi^-$ and $e^- + p \rightarrow e^- + \pi^+ + n$, it is concluded that this quantity must have a value less than 0.84 Fermi. A large weight in this number has the behavior of F(t) in the timelike region near threshold. (JFP)

4654 (JINR-D1,2-7781, pp 455-461) EXTREMELY INELASTIC ep SCATTERING. Bilen'kaya, S. I.; Bilen'kii, S. M.; Kazarinov, Yu. M.; Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

4655 (JINR-E2-8098) AMPLITUDE FOR PROCESS $\gamma\gamma \rightarrow \pi\pi$ IN CHIRAL QUANTUM FIELD THEORY. Pervushin, V. N.; Volkov. M. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 25p. Dep. NTIS (US Sales Only) $4.25.

The amplitude of process $\gamma\gamma \rightarrow \pi\pi$ is calculated in the chiral type quantum field theory for energies $|\sqrt{s}| < 1.2$ GeV. The values for pion polarizabilities are found ($\alpha_\pi \pm = 0.16\,\alpha/m_\pi^3$, $\alpha_{\pi^\circ} = -0.04\alpha/m_\pi^3$). (auth)

4656 (LBL-2496) COULOMB DISSOCIATION OF RELATIVISTIC DEUTERONS. Richardson, M. L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1973. Contract W-7405-eng-48. 16p. (CONF-731225-1). Dep. NTIS $4.00.

From west coast APS meeting; Berkeley, California, USA (27 Dec 1973).

Using the Weiszacker–Williams method of virtual quanta and a nonrelativistic perturbation theory calculation of the deuteron photodissociation cross section, the double differential cross section for Coulomb dissociation of relativistic deuterons is calculated. Numerical results are presented, and the application of the results to the subject of tagged neutron beams is discussed. (auth)

4657 (PURC-4159-15) SPIN DEPENDENCE IN INCLUSIVE COLLISIONS. Abarbanel, H. D. I.; Gross, D. J. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). [nd]. Contract AT(30-1)-4159. 10p. Dep. NTIS $4.00.

Polarization phenomena in inclusive reactions are shown to exhibit remarkably simple features from the point of view of J-plane physics with factorizable singularities. In particular, straightforward tests of factorization are proposed in single and multiple particle inclusive experiments initiated with polarized photon beams— real and virtual— or polarized proton targets. (auth)

4658 (TID-26658) HOW TO SEE THE LIGHT CONE. Gross, D. J.; Treiman, S. B. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). May 1971. Contract AT(30-1)-4159. 29p. Dep. NTIS $4.50.

New experiments which probe the behavior of products of electromagnetic currents at short and light-like distances are investigated. They require the detection of a massive μ-pair in electron-positron annihilation or in electroproduction. The former reaction is studied in detail and the (considerable) background is discussed. It is shown that, in suitable kinematic regions, one can approach both the Bjorken–Johnson–Low limit and the scaling limit, and put to severe test many recent ideas regarding products of currents. In the Bjorken–Johnson–Low limit one can test models of equal-time commutation relations and measure the spectral functions of an axial vector current. In the scaling region one can measure the matrix elements of the bilocal operators appearing in the light cone expansion of the product of electromagnetic currents, and test the tensorial structure of this expansion which emerges from quark models. Finally, in the inclusive reaction, where a massive μ-pair is produced in addition to any number of hadrons, the large hadronic mass limit of the cross section is completely determined in terms of a commutator of bilocal operators. (auth)

4659 GAUGE MODELS WITHOUT CHARMED HADRONS. Ross, G. G. (Rutherford Lab., Chilton, Eng.); Zia, R. K. P. Nuovo Cim.; 24A: No. 1, 61-72(1 Nov 1974).

The possibilities for constructing unified gauge models of the weak and electromagnetic interactions without charmed hadrons are investigated. Methods for suppressing both direct and induced strangeness-changing neutral currents are suggested, and their experimental consequences are considered. (auth)

4660 BREMSSTRAHLUNG MODEL FOR DEEP-INELASTIC ELECTRON–PROTON SCATTERING. Owens, J. R. Jr. Storrs, CT; Univ. of Connecticut (1974). 127p. University Microfilms Order No. 74-21,806.

Thesis (Ph.D.).

Deep-inelastic electron-proton scattering is studied in a bremsstrahlung model. The scattering is viewed in the rest frame of the incident electron, in which the momentum of the proton tends to infinity. The basic assumptions of the model are that the proton emits soft, neutral, massive vector mesons and that its transverse momentum remains finite. Most of the impulse which the proton receives takes place at the virtual photon-proton vertex, which is assumed to be that of a point charge. Analogous to bremsstrahlung in quantum electrodynamics, summations are carried out over approximate expressions for Feynman diagrams. All possible soft vector meson processes, both real and virtual, occurring before and after the photon vertex, are included. The assumption of softness leads to factorization of the vector meson contributions, so that their sum can be expressed in closed form as an exponential. The inelastic structure functions are then obtained as Fourier transforms of the exponential. Significant features of the model are the absence of explicit cut-offs in the momentum integrations—the assumptions of softness of the vector meson momenta and finiteness of the transverse momentum of the outgoing nucleon provide implicit cut-offs; the natural introduction of the coordinate space description for the structure functions; the prediction of the correct light cone singularity; and the prediction of Bjorken scaling for the inelastic structure functions. (Diss. Abstr. Int., B)

4661 ELECTROMAGNETIC INTERACTIONS OF ELEMENTARY PARTICLES. Landers, R. E. Atlanta; Georgia Inst. of Tech. (1974). 126p. University Microfilms Order No. 74-21,570.

Thesis (Ph.D.).

The quantum field operators used in the description of the interactions of elementary particles are not uniquely determined by Lorentz invariance requirements. Rather, these requirements restrict the fields which may be used to certain classes of fields dependent on the mass and spin of the particle to be described. To determine which field may be used for a particular particle it is necessary to compare theoretical results with experimental data involving that particle. The interaction of massive, spin $\frac{1}{2}$ particles with the electromagnetic vector potential is investigated. Fields which transform under Lorentz transformations according to finite-dimensional, irreducible representations of SL(2,c) are chosen from the class of fields available for massive, spin $\frac{1}{2}$ particles. A current operator is constructed from these fields and its matrix elements yield specific functions for the form factors of the particle. Form factors calculated in such a manner are in the form of polynomials in the momentum transfer; and unless several such polynomials are combined, the only particles which are described correctly are electrons and muons. (Diss. Abstr. Int., B)

4662 REDUCTION OF THE MODIFIED QUANTUM-MECHANICAL EQUATION FOR THE SYSTEM OF CHARGED DIRAC PARTICLES TO THE SUBSPACE OF POSITIVE ENERGY STATES. II. Janyszek, H. (Copernicus Univ., Turin). Acta Phys. Pol.; 5B: No. 5, 583-592(1974).

The problem of reducing the new quasirelativistic equation (including radiative corrections to the order c^{-3}) proposed previously is presented. The well known iterative Foldy–Wouthuysen method is simplified by introducing an intermediate scheme (generated by the generalized Case transformation) in the investigation of this equation. Supplementing this transformation by two simple unitary transformations, which have only an auxiliary meaning, brings this Hamiltonian to an even form. It is shown that the interpretation of this modified equation is free from difficulties and ambiguities of the Breit equation. All calculations are restricted to the c^{-3} term. (auth)

4663 COMMENT ON "IS THE PHOTON STABLE." Vasholz, D. P.; Parkinson, M. T. (Univ. of Florida, Gainesville). Lett. Nuovo Cim.; 11: No. 7, 400(19 Oct 1974).

The discussion of the photon includes a consideration of a previous conclusion that the processes $\gamma \rightarrow \gamma + g$ and $g \rightarrow 2\gamma$ do not go, which is based on the golden-rule formula. It is also pointed out that there is reason to hope that even very weak decays are not beyond the pale of experimental detection. (JFP)

4664 LIGHT–CONE ANALYSIS OF THE THREE–PHOTON PROCESS. Kiskis, J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 4, 1219-1224 (15 Aug 1974).

The three–photon process first treated by Brodsky, Gunion, and Jaffe in the parton model is analyzed in terms of light–cone singularities. It is found that certain physically reasonable assumptions suggested by the parton model lead to the dominance of the strongest singularities. (auth)

4665 BOOTSTRAP APPROACH TO SCALING AND FIXED POLES IN VIRTUAL COMPTON AMPLITUDES. Schierholz, G. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 4, 1261-1270 (15 Aug 1974).

It is shown that scaling and the $l = 0$ fixed poles can be explained in terms of bootstrap elements. This approach is strongly supported by recent investigations of the nature of the fixed poles while, in the scaling region, it turns out to be equivalent to the parton model. (auth)

4666 PSEUDO–GOLDSTONE PION MASSES IN A GAUGE MODEL. Yang, T.C. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 10: No. 4, 1251-1260 (15 Aug 1974).

A $SU_L(2) \otimes U(1) \otimes U(1)$ gauge model of electromagnetic and weak interactions is presented, which has three pseudo–Goldstone bosons identified as pions. We can include strong interactions in the pion masses without generating mass counterterms, if the strong gauge symmetry is U(1) or "color" SU(3). At the one–loop level (without strong interaction) the π^0 remains massless, while the $\pi^{\pm}$ pick up masses. From our analysis, the one–loop calculation should be interpreted as the electromagnetic and weak contribution to the pion mass–difference. Our result is not too large in magnitude as compared with the results found in other models. The pion mass difference including strong interactions has the same form as in the Weinberg model where pions are not pseudo–Goldstone bosons. We also exhibit formulas for the pion masses including strong interactions, which however we can not evaluate. (auth)

4667 COMPTON SCATTERING IN EXTERNAL MAGNETIC FIELDS. II. SPIN–1/2 CHARGED PARTICLES. Milton, K.A.; Tsai, W.; DeRaad, L.L. Jr. (Department of Physics, University of California, Los Angeles, California 90024); Hari Dass, N.D. Phys. Rev. D 10: No. 4, 1299-1309 (15 Aug 1974).

As a continuation of our efforts to calculate the total Compton cross section (to order α^2) in the presence of an arbitrary homogeneous magnetic field, we here report the result for the spin–1/2 case. The motion of the incident photon is restricted to lie along the direction of the field, but otherwise our result is quite general. Special limiting cases corresponding to classical and weak–field limits are discussed. (auth)

4668 INDUCED RADIATION OF ELECTRONS MOVING IN A FIELD OF TWO ELECTROMAGNETIC WAVES. Klimenko, Yu. I.; Pavlova, O. S.; Khudomyasov, A. I. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 4, 463–470(1974). (In Russian).

General expressions are obtained for the power of induced radiation of relativistic electrons moving in a field of two electromagnetic waves on irradiation by a third electromagnetic wave of lesser intensity. It is also shown that the induced radiation leads to a preferred orientation of electron spin. (SJR)

4669 INDUCED RADIATION OF AN ELECTRON IN HOMOGENEOUS CROSSED FIELDS. Dement'ev, A. S.; Pavlenko, Yu. G. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 4, 471–477 (1974). (In Russian).

By the methods of classical and quantum theories the spectral-angular distribution of power is found for the spontaneous and induced radiation of an electron moving in homogeneous, crossed magnetic and electric fields with $|E| < |H|$. (SJR)

4670 PARTON MODEL AND DEEP INELASTIC ELECTROPRODUCTION OF MUON PAIR. Choban, E. A. JETP Lett. (USSR) (Engl. Transl.); 19: No. 7, 258–260(5 Apr 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 7, 485–488(5 Apr 1974).

Deep inelastic electroproduction of a muon pair is considered in the kinematic region where the largest contribution is made by parton diagrams. The differential cross section of the process is obtained, and its comparison with experiment will make it possible to check on the validity of the parton model. (auth)

4671 SCATTERING OF SOFT PHOTONS ON ELECTRONS IN A MAGNETIC FIELD. Borisov, A. V.; Pavlenko, Yu. G. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 4, 439–442(1974). (In Russian).

It is shown that the scattering cross section of soft photons having a polarization vector projection different from zero in the direction of the magnetic field, as calculated from perturbation theory, has an infrared divergence $\sim \omega^3$, where ω is the energy of the incident photon. This divergence is removed in a theory which accurately takes into account the incident wave as an external field. This consideration is carried out in the nonrelativistic case. (SJR)

4672 MULTIPERIPHERAL CLUSTER MODEL FOR DEEP–INELASTIC SCATTERING. Hamer, C.J. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. D 10: No. 5, 1458-1467 (1 Sept 1974).

A multiperipheral cluster model for deep–inelastic scattering is constructed. The model is a possible realization of the Chou–Yang picture. The "pulverization products" of the virtual probe form a single cluster, whose decay is described by the statistical bootstrap model of Hagedorn and Frautschi. The remaining "fragmentation products" of the proton are assumed to have a multiperipheral cluster structure typical of ordinary hadron collisions. In order to obtain Bjorken scaling in deep–inelastic electron scattering, the pulverization cluster must have a mass of order $(Q^2)^{1/2}$; deep–inelastic experiments probe the mass dependence of the cluster vertex functions. Deep–inelastic hadron scattering should give final–distributions similar to those in deep–inelastic electron scattering. The crucial test of the model will be a search for single–cluster production at small ω. (auth)

4673 GAUGE–INVARIANT MODELS FOR TWO–BODY SCATTERING WITH THE BETHE–SALPETER LADDER APPROXIMATION. Hite, G.E. (Fachbereich Physik, Universität Trier–Kaiserslautern, 675 Kaiserslautern, Germany); Müller–Kirsten, H.J.W. Phys. Rev. D 10: No. 5, 1553-1560 (1 Sept 1974).

A natural and self–consistent method is given in the context of the ladder approximation of the Bethe–Salpeter equation for the construction of gauge–invariant models for two–body scattering involving photons. One vertex in these models is assumed to have structure and to be described by a Bethe–Salpeter equation. As examples, models for the following reactions are given: $\gamma N \rightarrow \gamma N$; $\gamma N \rightarrow \pi^{\pm,0} N$, $\rho^{\pm,0} N$; $\gamma\pi \rightarrow \gamma\pi$; $\gamma\pi \rightarrow \rho^{\pm,0}\pi$. (auth)

4674 AZIMUTHAL DEPENDENCE OF SEMI–INCLUSIVE DEEP–INELASTIC REACTIONS IN THE PARTON MODEL. Kingsley, R.L. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 10: No. 5, 1580-1586 (1 Sept 1974).

The parton model predicts that the coefficient of the terms dependent on the azimuthal angle in single–particle semi–inclusive deep–inelastic electroproduction should vanish asymptotically. This appears to be confirmed by experiment. In the light of this, we suggest that it may be possible to observe a significant azimuthal dependence in three similar reactions: two–particle semi–inclusive deep electron–positron annihilation, two–particle semi–inclusive deep–inelastic electroproduction, and single–particle semi–inclusive deep–inelastic electroproduction off a polarized target (without necessarily using a polarized beam). (auth)

4675 POSSIBLE NON–REGGE BEHAVIOR OF ELECTROPRODUCTION STRUCTURE FUNCTIONS. De Rújula, A.; Glashow, S.L.; Politzer, H.D. (Lyman Laboratory, Harvard University, Cambridge, Massachusetts 02138); Treiman, S.B.; Wilczek, F.; Zee, A. Phys. Rev. D 10: No. 5, 1649-1652 (1 Sept 1974).

The large–ω behavior of deep–inelastic structure functions, e.g., $F_2(\omega, q^2)$, is studied in the framework of asymptotically free field theories. On the basis of certain technical assumptions we predict an unbounded growth with ω: slower than any power of ω but faster than any power of $\log\omega$. (auth)

4676 $e^+e^- \rightarrow$ HADRONS: THE ROLE OF THE HIGGS SCALAR. Ma, E. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. D 10: No. 5, 1576-1579 (1 Sept 1974).

The possible role of the Higgs scalar with regard to e^+e^- annihilation processes is examined in three specific unified gauge models of the weak and electromagnetic interactions: (1) the 4–quark version of the Weinberg–Salam $SU(2) \times U(1)$ model, (2) the 8–quark version of the Georgi–Glashow SO(3) model, and (3) the Georgi–Glashow SU(5) model. A natural enhancement of the cross section for $e^+e^- \rightarrow$ hadrons is seen in all three, but of particular interest is the SU(5) model, where the cross section for $e^+e^- \rightarrow$ Higgs scalar $\rightarrow$ hadrons is of the order 10^2 times that for $e^+e^- \rightarrow$ Higgs scalar $\rightarrow \mu^+\mu^-$. This is suggested as a possible explanation of the observed rise in the ratio σ ($e^+e^- \rightarrow$ hadrons)/σ ($e^+e^- \rightarrow \mu^+\mu^-$) in recent colliding–beam experiments. (auth)

4677 SCALING IN INELASTIC ELECTRON–PHOTON SCATTERING. Zerwas, P. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 5, 1485-1493 (1 Sept 1974).

We study moments of the cross section for inelastic electron–photon scattering. Simple scaling laws would result if the real photon were a particle which behaves predominantly like a light vector meson. We discuss possible modifications of these scaling laws originating in anomalies of the structure functions of the photon; they occur in quark models as well as in generalized vector–meson–dominance models. (auth)

4678 LONGITUDINAL, MASSIVE PHOTON IN AN EXTERNAL MAGNETIC FIELD. Cover, R.A. (KMS Fusion, Inc., Ann Arbor, Michigan 48106); Kalman, G. Phys. Rev. Lett. 33: No. 18, 1113-1116 (28 Oct 1974).

The study of the vacuum polarization for strong magnetic fields reveals the existence of a massive, longitudinal photonlike resonance for magnetic fields exceeding $B \simeq m^2c^4/e^3$. (auth)

4679 BINDING CORRECTIONS FOR REACTIONS ON THE DEUTERON IN THE 3–3 RESONANCE REGION. Julius, D.I. (Institut für Theoretische Kernphysik, Universität Karlsruhe, Germany). Ann. Phys. (N.Y.) 87: No. 1, 17-39 (Sept 1974).

Binding corrections evaluated to all orders in a phenomenological nucleon–nucleon potential are compared with the leading term and with a double scattering correction in the Watson expansion for breakup and for coherent reactions on the deuteron at intermediate pion or photon energies. As principal result, we establish that for charged pion photoproduction, and for certain pion induced "spectator" reactions, the binding correction remains sufficiently small that truncation of the Watson expansion at terms of second order in the projectile–nucleon amplitudes is justifiable, but sufficiently large that it cannot be neglected in comparison with multiple scattering corrections. For the reactions $\pi^+d \rightarrow \pi^+p +$ spectator neutron and $\pi^-d \rightarrow \pi^-n +$ spectator proton, our theory predicts deviations from the simplest impulse approximation which become very large in well–defined kinematical regions, and should be easily accessible to experimental investigation. (auth)

4680 π^+/π^- RATIO IN INCLUSIVE PRODUCTION AND THE TRIPLE–REGGE FORMULA. Gandsman, J. (Laboratòire de l'Accélérateur Linéaire, Bât. 200, Université Parus–Sud, Centre d'Orsay, 91405–Orsay, France); Alexander, G.; Goren, Y.; Lissauer, D. Phys. Rev. D 10: No. 5, 1652-1654 (1 Sept 1974).

Recently it has been reported in a photoproduction experiment that the ratio of π^+/π^- is high in the target fragmentation region, yielding a value of 10 near $x = -1$. The presence of this backward peak has been confirmed in πp and pp experiments. We explain this result by applying the triple–Regge formalism for π^+ and π^- production. (auth)

4681 INTERACTION OF COHERENT ELECTROMAGNETIC WAVES WITH RELATIVISTIC ELECTRONS IN A MEDIUM. Schneider, S.; Spitzer, R. (Stanford Univ., CA). Nature (London); 250: No. 5468, 643-645(23 Aug 1974).

A mechanism is proposed for producing coherent photons by the interaction of relativistic electrons moving with velocity greater than the electromagnetic phase velocity) with coherent electromagnetic waves moving in the opposite direction. Its applications include the production of narrow band radiation at higher frequencies and wave numbers than are at present available from lasers, having implications for holography and for improved pumping efficiency, and the production of narrow band submillimeter waves from microwaves, having a significance for communications work. (UK)

4682 MAGNETIC FORM FACTOR DETERMINATION BY INELASTIC SCATTERING OF NEUTRONS AS COMPARED TO ELASTIC SCATTERING MEASURES. Sacchetti, F. (CNEN, Casaccia, Italy). Solid State Commun.; 15: No. 6, 963-964(15 Sep 1974).

The difference between the magnetic form factor for elastic and inelastic scattering of neutrons is derived to interpret recent neutron scattering experiments. (auth)

4683 GAUGE INVARIANCE AND RELATIVISTIC RADIATIVE TRANSITIONS. Grant, I. P. (Oxford Univ.). J. Phys., B (London); 7: No. 12, 1458-1475(21 Aug 1974).

The gauge invariance of the matrix elements of the electromagnetic interaction is a property that is usually taken for granted. This paper describes a unified derivation in which the dependence of the matrix elements on the gauge in which the electromagnetic potentials are written is exhibited explicitly. The necessary and sufficient condition for the transition matrices for all multipoles to be gauge invariant is that the transition matrix for longitudinal photons should vanish identically. This imposes conditions on the initial and final wavefunctions which are automatically satisfied for a single-particle model but may not necessarily hold in, say, the Hartree–Fock model. For electric dipole transitions, it is shown that the Coulomb gauge leads to the dipole velocity form of the matrix element in the nonrelativistic limit and that a different choice is needed to give the dipole length form. Arguments are advanced suggesting that the dipole velocity form should be given a privileged position in approximate calculations of atomic and molecular transition probabilities. (auth)

4684 ELECTROMAGNETIC RADIATION PRODUCED BY A RELATIVISTIC CHARGE PASSING THROUGH A HOLE IN A CONDUCTING PLATE. Hemp, J. (Oxford Univ.). Quart. J. Mech. Appl. Math.; 27: 255-262(May 1974).

A method is given for calculating the electromagnetic waves produced when a point charge moves uniformly through a circular hole in a conducting screen at a speed very close to the speed of light. Use is made of the fact that the field of the charge closely resembles a packet of waves of mainly high frequency. The radiation is supposed to arise from the reflection of this packet of waves at the screen. The nature of the radiation at infinity is calculated by means of Fraunhofer diffraction theory. The case of a line charge passing a conducting half-plane is treated in the same manner and the result is compared with an exact solution of the problem. (auth)

4685 ANALYTIC PROPERTIES OF FORWARD ELASTIC SCATTERING AMPLITUDES RESULTING FROM MICROCAUSALITY. Geshkenbein, B. V.; Komech, A. I. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 20: No. 3, 562-568(Sep 1974). (In Russian).

The amplitudes $T_i(v,q^2)$ ($i = 1,2$) of forward elastic scattering of a virtual photon with the mass q^2 are considered in the variables $q^2 = e^{2\sigma}$, $v = e^{\sigma}\mathrm{ch}\,\varphi$. it is proved that the microcausality condition results in the analyticity of the amplitudes as a function of both the complex variables σ and φ in a tube $|\mathrm{Im}\,\sigma + \pi/2| + |\mathrm{Im}\,\varphi| < \pi/2$. The formulas which relate the amplitudes $T_i(v,q^2)$ at arbitrary complex v and q^2 to the functions $W_i^{(-)}(v',q'^2)$ describing the electroproduction ($-2v' < q'^2 < 0$) are obtained. (auth)

4686 BREMSSTRAHLUNG OF A HEAVY PHOTON. Zima, V. G. (Kharkov State Univ.). YAFIA; 20: No. 3, 514-518(Sep 1974). (In Russian).

Cross section is calculated for the bremsstrahlung of the hypothetical massive neutral vector boson, the Z boson, in muon-hadron collisions (the Z boson is emitted by the muon, the μZ coupling is an arbitrary superposition of vector and axial-vector). The high energy asymptotics of the total cross section is calculated with logarithmic accuracy. Electromagnetic structure of the target is taken into account by means of an effective cut-off in the momentum transfer. In case of point-like target the asymptotics is calculated with power accuracy. It is shown that in the high energy limit the dependence on the pseudovector coupling is factorized out. (auth)

4687 CHARGE CORRELATIONS IN THE MULTIPERIPHERAL MODEL WITH BRANCHING. Levin, E. M.; Ryskin, M. G. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 20: No. 3, 519-531(Sep 1974). (In Russian).

It is shown that the branch points, i.e., emission of several multiperipherally produced particles result in a strong dependence of the mean number of π^0 mesons upon the number of π^- mesons $\langle n^0(n^-)\rangle = n^-$ and allow one to explain the KNO scaling at present-day energies. The behavior of the quantity $\langle n^0(n^-)\rangle$ is studied as a function of the correlations (caused by production of resonances and by the finiteness of the phase space) inside a separate multiperipheral emanation point. The numerical results for several simple models agree well with experiment. (auth)

4688 MESON IN FIELD OF A PLANE ELECTROMAGNETIC WAVE. Fedorov, F. I.; Radyuk, A. F. (Inst. of Physics, Minsk). Yadern. Fiz.; 20: No. 3, 509-513(Sep 1974). (In Russian).

General solution of the problems of scalar and vector mesons in field of a plane electromagnetic wave is obtained by a covariant way. All three linear-independent solutions of the problem for the vector meson are found in an explicit four-dimensional covariant form. (auth)

4689 PARTON DISTRIBUTION FUNCTIONS IN THE PERTURBATION THEORY. Burkhvostov, A. P.; Lipatov, L. N.; Popov, N. P. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 20: No. 3, 532-548(Sep 1974). (In Russian).

The Feynman parameter x distribution function D_i^j are calculated in the approximation $g^2 \ln(\Lambda/q^2) \sim 1$, $g^2 \ll 1$ for the pseudoscalar and vector theories with the isotopic invariant interaction $(\bar{\psi}\gamma_5\tau\psi)\varphi$ and $(\bar{\psi}\gamma_\mu\psi)V_\mu$ respectively. The results are used to discuss the relation of the structure functions for deeply inelastic ep and vp scattering to the e^+e^- annihilation to hadrons. (auth)

4690 PHYSICAL FORMFACTORS AND COVARIANT PARAMETRIZATION OF ELECTROMAGNETIC CURRENT FOR

PARTICLE WITH ARBITRARY SPIN. Kirichenko, I. K.; Stepanovskii, Yu. P. (Physical-Technical Inst., Kazan). Yadern. Fiz.; 20: No. 3, 554-561(Sep 1974). (In Russian).

Matrix elements of the electromagnetic current for a particle with arbitrary spin are expressed in a covariant way in terms of form factors that are the electric and magnetic multipole moments in the Breit reference frame. (auth)

4691 SUPERGAUGE ALGEBRA AND ELECTROMAGNETIC INTERACTION OF THE DUAL PION MODEL. I. Konisi, G. (Kwansei Gakuin Univ., Nishinomiya, Japan); Matsuda, S.; Nakawaki, Y.; Saito, T. Progr. Theor. Phys. (Kyoto); 51: No. 3, 893-911(Mar 1974).

The electromagnetic problems of the dual pion model proposed by Nevcu and Schwarz are considered. The photon gauge substitution and the supergauge algebra appearing in this model are shown to determine the interaction uniquely. Consequently it is found that the electric charge has only two localization points which are at the ends of the string and that new gauge conditions hold, which are crucial for proving the no-ghost theorem in the theory. Also a proof is given of the photon-gauge invariance of the system and the conserved dual current is found. Unfortunately one is forced to stay in the on-shell world (i.e., massless photon). (auth)

Weak

Refer also to abstract 4470.

4692 (FAI-15) $K^{\pm}_{\mu 3}$ DECAY AND COUPLING WITH DERIVATIVES IN A MUON CURRENT. Kutuzova, G. B. (AN Ehstonskoj SSR, Tartu. Inst. Fiziki i Astronomii). 1972. 38p. (In Russian). INIS.

A model of weak interactions was examined, in which, with an unchanged V−A structure (ev_e) of the electron current, a more general expression for (μv_r) of the muon current was used where derivatives and small V + A impurities were included in the structure. The probability of π^0 and μ^+ meson spectra, the Dalitz-graph density, and the polarization of muons of $K^{+}_{\mu 3}$ decay were calculated. Deviations from V−A theory predictions estimated for $K^{\pm}_{\mu 3}$ decay with known impurities were obtained in examination of $\mu \rightarrow e$ and $\pi \rightarrow \mu$ decay. It is shown that the introduction of new parameters improves the agreement between theory and experiment. The contribution of bonds with derivatives is compared with that from strong interactions and may lead to a $K_{\mu 3}$ decay in the form of an increase in the parameter λ_+ compared with the measured value in K_{e3} decay. (tr-auth)

4693 (JINR-D1,2-7781, pp 363-377) NEW PROBLEMS IN THE PHYSICS OF WEAK INTERACTIONS. Bilen'kii, S. M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

4694 (JINR-D1,2-7781, pp 403-417) FORM FACTORS IN $K^0_{\mu 3}$ DECAYS. Berlin-Budapest-Dubna-Prague-Sofia-Serpukhov Collaboration. 1974. (In Russian).

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

4695 $O_4^{\Pi C}$ ANALYSIS OF POSSIBLE COMPOSITE LEPTON STATES GENERATED BY WEAK INTERACTIONS. Furlan, P. (Univ., Trieste, Italy). Nuovo Cim.; 24A: No. 1, 1-48(1 Nov 1974).

The possibility of existence of lepton-antilepton massless vector bound states due to weak interactions is investigated with the help of a spinor-spinor Bethe-Salpeter equation in the ladder approximation. A phenomenological kernel is used, reproducing at large distances the x^{-6} behavior of the long-range forces due to exchange of neutrino pairs between leptons and being logarithmically divergent at short distances. After expansion of the amplitude into $O_4^{\Pi C}$ generalized harmonics, the equation is reduced to three systems of coupled Fredholm integral equations for the spectral functions, each system corresponding to different O_4 and/or ΠC quantum numbers. In the zeroth-order approximation the form factor of the vertex is given for general values of the quantum numbers, and the relative effective renormalized coupling constant computed. It turns out that the only physically acceptable solutions correspond to bound states of spin 1, $\Pi C = +1$. They may belong either to the representation $(\frac{1}{2}, \frac{1}{2})$ of O_4 or to $(1, 0) \oplus (0, 1)$; in the former case the effective renormalized coupling constant turns out to be a pure number $(2\pi\sqrt{3})$, while in the second case its value depends on the masses of the constituent leptons and, for the electron, is about 0.70. (auth)

4696 ELECTROMAGNETIC FORM-FACTOR OF THE NEUTRINO IN ATTENUATION THEORY. Gal'tsov, D. V.; Nikitina, N. S.; Safronov, A. N. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 3, 265-272(1974). (In Russian).

A finite expression (not containing a cutoff momentum) is obtained for the electromagnetic form factor of a neutrino in a K-matrix model of a four-fermion weak interaction. (SJR)

4697 PROPERTIES OF SCATTERING AMPLITUDES THAT INCREASE LINEARLY WITH ENERGY. Mickens, R. E. (Fisk Univ., Nashville). Acta Phys. Pol.; 5B: No. 5, 659-662(1974).

Properties of scattering amplitudes that lead to cross sections increasing linearly with energy. A possible application is to neutrino-nucleon scattering. (auth)

4698 NEUTRAL WEAK CURRENTS: THE NEUTRINO NUMBER CURRENT AND THE CORRESPONDING $\Delta Y = 0$ HADRONIC WEAK CURRENT. Griffith, R. W. (Univ., Bonn). Lett. Nuovo Cim.; 11: No. 7, 401-410(19 Oct 1974).

It is reported that within the framework of a low energy phenomenological current−current weak interaction, remarkably simple considerations lead theoretically to the existence of particular weak neutral currents. These currents are the lepton number current of the neutrino and a $\Delta Y = 0$ hadronic weak current whose vector component is proportional to the sum of the baryon number current and the hadronic electromagnetic current. Bounds on the relative-scale constant for two different values of the angle are given for the cross sections of $\nu_\mu + N$ and $\bar{\nu}_\mu + N$ interactions. (JFP)

4699 CALCULATION OF THE PSEUDOTENSOR FORM FACTOR IN HYPERON BETA DECAY. Stremnitzer, H. (Univ., Trieste, Italy). Lett. Nuovo Cim.; 11: No. 7, 411-416(19 Oct 1974).

Another approach, that of the saturation of current algebra sum rules, to the problem of obtaining an estimate for the pseudotensor form factor induced by symmetry-breaking effects in the semileptonic decays of hyperons described by the Cabibbo theory is presented. (JFP)

4700 PRODUCTION OF NEUTRAL WEAK BOSONS IN HIGH−ENERGY ELECTRON AND MUON EXPERIMENTS. Brown, R.W.; Gordon, L.B.; Mikaelian, K.O. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. Lett. 33: No. 18, 1119-1121 (28 Oct 1974).

We discuss the theoretical total and differential cross sections for Z^0 production in the reaction $l+N \rightarrow N'+Z^0+l$, including remarks about polarization effects and subsequent leptonic decays. Brief mention is made about production of Z^0's by neutrino beams and of scalar mesons. (auth)

4701 RADIATIVE CORRECTIONS TO $K_L \rightarrow \mu^+\mu^-$. Gokhale, M.P.; Patil, S.H. (Department of Physics, Indian Institute of Technology, Bombay−76, India). Phys. Rev. D 10: No. 5, 1619-1623 (1 Sept 1974).

Radiative corrections to the unitarity bound for the decay $K_L \rightarrow \mu^+\mu^-$ are studied in detail. Unlike the three−particle intermediate state (e.g., the $2\pi\gamma$ state) these corrections tend to enhance the decay amplitude and give a significant contribution (~ 17% of the theoretical lower bound given by the 2γ state) to the decay rate. (auth)

4702 HEAVY LEPTONS IN AN O(4) GAUGE MODEL. Cheng, T.P.; James, P.B. (Department of Physics, University of Missouri —St. Louis, St. Louis, Missouri 63121). Phys. Rev. D 10: No. 5, 1643-1645 (1 Sept 1974).

Heavy−lepton contributions to the magnetic moment of the muon are calculated in the framework of a unified theory of weak and electromagnetic interactions based on a strict O(4) gauge group. The model, previously reported, incorporates the Han−Nambu quarks, CP violation, and leads to a kinematic $\Delta I = 1/2$ rule for nonleptonic weak processes. This calculation shows that recent experimental results can definitely rule this model out; implications to general models based on the O(4) group are discussed. (auth)

4703 CALCULATION OF THE WEAK−DECAY PARAMETER RATIO $f_K/f_\pi f_+(0)$. Kenny, B.G. (Research School of Physical Sciences, The Australian National University, Canberra, Australia). Phys. Rev. D 10: No. 5, 1658-1659 (1 Sept 1974).

Making use of standard smoothness assumptions together with a recent soft−pion theorem due to Mathur and Yang, the weak−decay parameter ratio $f_K/f_\pi f_+(0)$ is successfully calculated. (auth)

4704 UNITARIZED HARD−MESON CALCULATION OF K_{l_3} FORM FACTORS. Ali, A.; Razmi, M.S.K. (International Center for Theoretical Physics, Trieste, Italy); Hussain, F. Ann. Phys. (N.Y.) 87: No. 1, 40-59 (Sept 1974).

K_{l_3} form factors are studied in the analytic hard−meson framework. The Gell−Mann−Oakes−Renner model for chiral $SU(3) \times SU(3)$ symmetry breaking is employed to determine the so called σ−terms and current divergences. PCAC is used for the $\pi-$ and K−mesons, and two−particle unitarity is used for the 1^- and 0^+ channels. The results depend on the Kappa−meson mass. Results are presented for the slope of the divergence form factor λ_0, the ratio $\xi=f_-(0)/f_+(0)$, and the width of the Kappa meson, for $m_\kappa=900$ and 1100 MeV. It is found that the κ has a large width, and the prediction for λ_0 and ξ are in quantitative agreement with the recent experiments. (auth)

Strong (General)

Refer also to abstracts 4589, 5063, and 5119.

4705 (COO-881-412) REACTION MECHANISMS AT HIGH ENERGY. Barger, V. (Wisconsin Univ., Madison (USA). Dept. of Physics). 1974. 76p. (CONF-740713-28). Dep. NTIS $8.00.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

The lecture on reaction mechanisms at high energy covers bounds from field theory, real parts of scattering amplitudes with an analytic derivative relation, proton−proton scattering, symmetry predictions for exchange couplings, πN charge-exchange reactions, the state of the art for the phenomenology of inelastic reactions, and double charge-exchange reactions with Regge−Regge cuts. (JFP)

4706 (COO-1768-204) RESONANCE SPECTROSCOPY (THEORY). Rosner, J. L. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1974. Contract AT(11-1)-1768. 29p. Dep. NTIS $4.50.

The review covers constituent quarks including the spectrum, SU(6)w constituents, duality, confinement of quarks, and charm; and current quarks including transitions and sum rules, mixed representations, the Melosh transformation, phenomenological applications, specific models and problems at $q^2 \neq 0$ and elsewhere. (JFP)

4707 (COO-3072-25) HADRONIC FORM FACTORS IN ASYMPTOTICALLY FREE FIELD THEORIES. Gross, D. J.; Treiman, S. B. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). 1974. Contract AT(11-1)-3072. 15p. Dep. NTIS $4.00.

The breakdown of Bjorken scaling in asymptotically free gauge theories of the strong interactions is explored for its implications on the large q^2 behavior of nucleon form factors. Duality arguments of Bloom and Gilman suggest a connection between the form factors and the threshold properties of the deep inelastic structure functions. The latter are addressed directly in an analysis of asymptotically free theories; and through the duality connection one is then led to statements about the form factors. For very large q^2 the form factors are predicted to fall faster than any inverse power of q^2. For the more modest range of q^2 reached in existing experiments the agreement with data is fairly good, though this may well be fortuitous. Extrapolations beyond this range are presented. (auth)

4708 (ITF-74-95E) LARGE TRANSVERSE MOMENTS IN THE HYDRODYNAMICAL MODEL OF MULTIHADRON PRODUCTION. Gorenshtein, M. I.; Zinov'ev, G. M.; Pavlenko, O. P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 9p. Dep. NTIS (US Sales Only) $4.00.

The problem of large transverse momenta of secondaries is considered in frame of hydrodynamical model of multihadron production. The "evaporation" mechanism is suggested. In accordance with it, large transverse momenta can appear as a result of particle emission during the stage of hydrodynamical system expansion at temperature $T > T_{c\mu} \approx \mu$ (μ is the mass of π-meson). The calculation is performed in the one-dimensional approximation. Comparing the results with the experimental data one can make some conclusions concerning possible equation of state of hadron matter. (auth)

4709 (JINR−D-6004) BINARY REACTIONS OF HADRONS AT HIGH ENERGIES. Proceedings of the International Seminar, Dubna, June 3−8, 1971. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 768p. (In Russian and English). (CONF-710671−).

Separate abstracts were prepared for each of the papers. (JFP)

For abstracts of individual papers see: 4586−4590, 4607−4611, 4632, 4652, 4710−4715, 4749−4753, 4770, and 4806.

4710 (JINR−D-6004, pp 363-392) ASYMPTOTIC THEORIES. Nguen Van Kh'eu. (Inst. of Physics, Hanoi, North Korea). 1972. (In Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4711 (JINR−D-6004, pp 393-439) MODELS FOR HIGH ENERGY COLLISIONS OF HADRONS. Quigg, C. (State Univ. of New York, Stony Brook). 1972.

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

Following general opening remarks, three specific phenomenological problems are discussed. For two-body scattering, the questions of the role of Regge cuts and the spin structure of scattering amplitudes are considered. Comments are made on inclusive reactions and their relation to two-body channels. Throughout, emphasis is placed upon the suggestion of useful experiments. (auth)

4712 (JINR−D-6004, pp 440-465) QUASIPOTENTIAL DESCRIPTION OF BINARY HADRON REACTIONS AT HIGH ENERGIES. Matveev, V. A.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4713 (JINR−D-6004, pp 466-522) BINARY REACTIONS IN THE THEORY OF COMPLEX MOMENTS. Ter-Martirosyan, K. A. (Inst. of Theoretical and Experimental Physics, Moscow). 1972. (In Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4714 (JINR−D-6004, pp 633-651) STUDY OF BINARY HADRON REACTIONS BY THE METHOD OF DISPERSION RELATIONS. Solov'ev, L. D. (Inst. of High Energy Physics, Serpukhov, USSR). 1972. (In Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4715 (JINR−D-6004, pp 705-728) USE OF EXTRAPOLATION TECHNIQUE IN ANALYSIS OF EXPERIMENTAL DATA ON BINARY REACTIONS. Fischer, J. (Inst. of Physics, Prague). 1972.

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

Ways in which analyticity of the scattering amplitude can and is exploited more precisely and completely are shown. Also an effective combination of experimental information with the requirement of analyticity in order to make conclusions about the amplitude beyond the experimentally attainable region is discussed. A brief review of the methods and results in this field is given. (JFP)

4716 (JINR-D1,2-7781, pp 11-39) PRESENT STATUS OF HADRON SPECTROSCOPY. Simak, V. (Inst. of Physics, Prague). 1974.

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

The review of hadron spectroscopy covers a brief summary of hadrons, meson resonances, baryons, systematics, and new experiments. (JFP)

4717 (JINR-D1,2-7781, pp 40-87) LARGE TRANSVERSE MOMENTA IN INELASTIC HADRON−HADRON COLLISIONS. Sosnowksi, R. (Inst. for Nuclear Research, Warsaw). 1974.

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

The review of the production of particles with large transverse momenta covers the general situation in transverse momentum distribution in high energy hadronic collisions, which is dominated by low transverse momentum values, the experimental data, and possible mechanisms responsible for the production of particles with very high transverse momenta. (JFP)

4718 (JINR-D1,2-7781, pp 328-336) MULTIPLICITY SCALING IN HADRON COLLISIONS. Simak, V. (Inst. of Physics, Prague). 1974.

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

Two basic features of multiparticle reactions, scaling of $\langle n\rangle/D$ ratio and KNO scaling at high energies are described in a suggested distribution. The scaling function $\psi(z)$ is derived from the Polya distribution and corresponding multiplicity momenta are compared with experiment. It is shown that different kind of reactions (e.g., annihilations) in this frame may have different scaling functions. (auth)

4719 (JINR-P2-8043) MULTIPLICITY DISTRIBUTIONS AND RELEVANT VALUES IN THE PARTON MODEL OF HAD-

RONS. Dushutin, N. K.; Mal'tsev, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

In the framework of the parton model the integral characteristics of the hadron multiple generation (multiplicity distributions, integrated correlation functions, etc.) are discussed. Various variants of the models (point-like partons, hadron system of constant density in the rapidity space, partons-"strings") are considered. The multiple generation of particles is represented through stochastic "elementary" processes of hadron interactions. Then the multiplicity distribution for secondaries is defined by solution of the system of differential-difference equations (of the type of the Chapmen-Kolmogorov equations). A few versions of solving these equations (depending on type of elementary processes) are analyzed. The obtained results are compared with available experimental data. (auth)

4720 (PURC-4159-43) DUAL QUARK-GLUON MODEL OF HADRONS. Schwarz, J. H. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). Sep 1971. Contract AT(30-1)-4159. 14p. Dep. NTIS $4.00.

A possible method for constructing a dual-resonance model of hadrons out of mathematical quarks and gluons is proposed. A quark emission vertex is derived. (auth)

4721 INVESTIGATION OF FOUR–MESON SYMMETRIC–GROUP DUAL MODELS. Frampton, P.H.; Geer, K.A. (Department of Physics, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 10: No. 4, 1284-1288 (15 Aug 1974).

Some proposals for four–meson dual Born amplitudes with S_3 invariance are analyzed in detail. For the simplest example we give a rigorous proof of an earlier assertion, which has been called spin–lowering symmetry. We then examine the implementation of the Adler consistency condition and derive a general expression for models having an Adler zero. Finally the results of a search for ghost–free examples are reported. (auth)

4722 CURRENT QUARKS AND CONSTITUENT QUARKS: SYMMETRY BREAKING AND INTERACTION. Fuchs, N.H. (Physics Department, Purdue University, West Lafayette, Indiana 47907). Phys. Rev. D 10: No. 4, 1280-1283 (15 Aug 1974).

A study is made of the question of how different the correct transformation V from the current–quark to constituent–quark basis is expected to be from the free mass–degenerate quark model discussed by Melosh. The effect of SU(3) mass breaking and of mutual interaction of the quarks is discussed in the context of a simple model. The algebraic properties of V are more complicated than that of V_{free}, the transformation constructed by Melosh; nevertheless, it still is tractable enough so an attack may be made on the problem of mass splitting in SU(6) multiplets. (auth)

4723 DOUBLE–CHARGE–EXCHANGE REACTIONS AND REGGE–REGGE CUTS IN A DUAL REGGE MODEL. Duke, D.W.; Dean, N.W. (Ames Laboratory–USAEC and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. D 10: No. 5, 1481-1485 (1 Sept 1974).

A model which previously achieved a good quantitative description of 19 different $0^- 1^+/2 \rightarrow 0^- 1^+/2$ reactions is extended to double–charge–exchange reactions. The underlying mechanism is double Regge exchange, calculated in an SU(3) –symmetric dual absorptive model. The results depend on whether a nonet or an octet of mesons is assumed in the intermediate state; strong theoretical reasons for favoring a nonet are given. The amplitudes obtained in the previous model produce good quantitative agreement with recent data on $\pi^- p \rightarrow K^+\Sigma^-$, $K^- p \rightarrow \pi^+\Sigma^-$, and $K^- p \rightarrow K^+\Xi^-$ forward differential cross sections. (auth)

4724 UNITARITY AND THRESHOLD EFFECTS OF DIFFRACTIVE PRODUCTION. Kang, K. (Department of Physics, Brown University, Providence, Rhode Island 02912). Phys. Rev. D 10: No. 5, 1527-1531 (1 Sept 1974).

Within the context of a general unitarization scheme of Baker and Blankenbecler and others, we reconsider the necessary ingredients needed to define a class of Feynman–diagram models at high energies. We then discuss the relationship between the threshold behavior in the total cross section of the diffractive production and the choice of the kernels that defines a class of diagrams. (auth)

4725 FRAGMENTATION AND ENERGY CONSERVATION IN THE EIKONAL–REGGE MODEL. Chang, S. (Department of Physics, University of Illinois, Urbana, Illinois 61801); Yan, T. Phys. Rev. D 10: No. 5, 1531-1549 (1 Sept 1974).

We have studied the effect of fragmentation and energy conservation in the eikonal–Regge model. A generalized eikonal representation involving multi–impact parameters is given for the elastic and inelastic amplitudes when fragmentation takes place. The generalized eikonal function depends on more than one impact parameter which describes a many–body potential. In the strong–absorption model and at high energy, however, the elastic amplitude can be approximated by a single–impact–parameter representation with an effective eikonal function. As a result of the fragmentation, we find that although σ_E and σ_T still increase as $\ln^2 s$, their ratio is no longer 1/2. Instead, it is the sum of the elastic and diffractive cross sections which remains to be one half of the total cross section. To enforce the energy conservation, we proposed a thermodynamic approach by introducing an impact–parameter–dependent temperature. Using well–known thermodynamics relations, we obtain various corrections to the naive eikonal–Regge model predictions due to energy conservation. Experimental consequences are discussed. (auth)

4726 DISTINGUISHING BETWEEN MODELS FOR LARGE–TRANSVERSE–MOMENTUM PROCESSES BY A MEASUREMENT OF JET–ASSOCIATED BARYON NUMBER. Newmeyer, J.L.; Sivers, D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 5, 1475-1480 (1 Sept 1974).

We propose that a measurement of the number of protons and antiprotons in the hemisphere opposite a large transverse–momentum proton can distinguish between two important models for large transverse–momentum processes. The parton jet model (PJM), where the underlying mechanism is assumed to be quark–quark scattering, is characterized by a surplus of protons over antiprotons in the jet opposite the detected proton, while the constituent interchange model (CIM) predicts that the jet opposite the trigger proton be populated on the average by more antiprotons than protons. (auth)

4727 I. MULTI-REGGE APPROACH TO THE DIFFRACTIVE DISSOCIATION REACTION $\pi \rightarrow 5\pi$. II. RIGOROUS UPPER BOUNDS ON THE WAVE RENORMALIZATION CONSTANT OF DEUTERON. Celik, T. Rochester, NY; Univ. of Rochester (1974). 154p. University Microfilms Order No. 74-22,568. Thesis (Ph. D.).

There are diffractively produced enhancements observed in the effective mass distribution of high energy inelastic scattering processes. These enhancements possess many resonance-like properties and are easily identified; but nevertheless, due to the fact that they are not observed in any processes other than the diffractive dissociation reactions, their true nature is not fully understood. Although, from the theoretical point of view, some models provided a reasonable fit to the diffractively produced enhancements in 3π and $K\pi\pi$ mass spectrum, the mechanism for producing these excitations is to be examined in further detail. The diffractive dissociation reaction $\pi \rightarrow 5\pi$ is investigated in terms of the multi-Regge models involving one Pomeranchukon exchange. Two classes of models, those in which the A_1 is treated as a final-state particle and there are two Regge exchanges, and those involving three Regge exchanges, were considered. In both cases an enhancement is obtained in the five-pion mass spectrum, which, for certain values of the parameters becomes independent of the overall energy and momentum transfer, and simulates resonance behavior. Also, it is observed that the multi-Regge graph with the $\rho\rho\pi$ final state gives an excellent fit to the coherent 5π production data above the $\rho\rho\pi$ threshold. One of the most interesting problems of present day physics is to find out as to what degree and with what rigor one can know about the "elementary" or "composite" structure of the matter. The wave renormalization constant, Z, measures the probability of finding a bare (elementary) particle inside the dressed, physical particle and, serves as a compositeness criterion. An upper bound is derived for Z_D of deuteron which, due to its widely believed known structure, appears to be the best candidate for an investigation in this line. Following a brief introduction, the mathematical methods employed in the calculations are presented. The requisite formal preliminaries are developed by defining the deuteron propagator, introducing the proper and improper vertex functions associated with the neutron-proton-deuteron vertex, and studying other related quantities. Rigorous upper bounds on Z_D, as well as a bound on the deuteron-nucleon coupling constant are derived. These bounds stand as a direct consequence of basic requirements in any physical theory, such as causality, unitarity, etc. (Diss. Abstr. Int., B)

4728 A RELATIVISTIC QUARK MODEL FOR BARYONS. Kellett, B.H. (Department of Natural Philosophy, University of Glasgow, Glasgow, G12 8QQ Scotland). Ann. Phys. (N.Y.) 87: No. 1, 60-94 (Sept 1974).

The Bethe–Salpeter equation for the relativistic three-quark bound state is solved for an instantaneous interaction in the ladder approximation. The particular solution obtained is valid for simple potentials in both the weak- and strong-binding situations. The general method for calculating matrix elements for the interaction of the bound state with an external electromagnetic field is presented. Particular attention is paid to the emergence of the nonrelativistic quark model interaction as the lowest-order approximation in a perturbative expansion in the inverse quark mass. Relativistic corrections to this approximation are investigated, and their importance is seen to depend on the quark mass. For light quarks these corrections can be large; and to reproduce the proton magnetic moment, for instance, a substantial anomalous moment is necessary. The model has several encouraging features. The form factors with a harmonic potential have an asymptotic k^{-1} behavior, and the relativistic corrections to the SU(6) results for the form factors are of the correct order of magnitude. (auth)

4729 LEPTON PAIR PRODUCTION IN HADRON–HADRON COLLISIONS. Paar, H.P. (Columbia University, New York 10027); Paschos, E.A. Phys. Rev. D 10: No. 5, 1502-1509 (1 Sept 1974).

Lepton production in hadron–hadron collisions is studied in a class of models. In the conventional quark–antiquark annihilation mechanism, the parton distributions incorporate the latest experimental information. The numerical estimates bring out unique signatures and represent realistic upper bounds. In studying the dependence of the results on different quark schemes we find that in models with charm the results remain practically unchanged, or are reduced by a multiplicative factor. We conclude that should the rates be considerably larger than the estimates, then they must be attributed to another origin. (auth)

4730 COHERENT STATES AND PARTICLE PRODUCTION. II. ISOTOPIC SPIN. Botke, J.C.; Scalapino, D.J.; Sugar, R.L. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. D 10: No. 5, 1604-1612 (1 Sept 1974).

The coherent–state representation is used to discuss the production of isovector pions. Techniques are developed for constructing states of definite isotopic spin and G parity, and a variety of models are discussed. Particular attention is paid to correlations between charged and neutral pions which appear to play an important role in the understanding of the underlying dynamics. (auth)

4731 PRODUCTION OF NEUTRONS BY COSMIC RAYS AT VARIOUS DEPTHS UNDERGROUND. Gorshkov, G. V.; Zyabkin, V. A. Sov. At. Energy (Engl. Transl.); 34: No. 3, 269-271 (Mar 1973).

Translated from At. Energ. (USSR); 34: No. 3, 210-213(Mar 1973).

The rate of production of neutrons in lead, cadmium, iron, and aluminium at depths up to 1000 m water equivalent the nuclear-active (w. e.) cosmic ray component, slow negative muons, and high energy muons was calculated. (JFP)

4732 GRAVITON EMISSION IN HIGH ENERGY HADRON COLLISIONS. Kobzarev, I. Yu.; Peshkov, P. I. Zh. Eksp. Teor. Fiz.; 67: No. 2, 428-432(Aug 1974). (In Russian).

An expression is derived for the probability of emission of soft gravitons in elastic and inelastic collisions of hadrons possessing energies considerably exceeding their mass. The fraction of energy transferred to the gravitons is estimated. (auth)

4733 PERIPHERAL ORBIT MODEL. Hara, Y.; Kuroda, T.; Takaiwa, Y. (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 51: No. 3, 840-858(Mar 1974).

A peripheral orbit model, in which an incoming hadron is assumed to revolve in a peripheral orbit around a target hadron, is proposed. The nondiffractive parts of two-body reaction amplitudes of hadrons are expressed in terms of the radius, width and absorptivity of the orbit. The radius of the orbit is about 1 fm and the width of the orbit is determined by the range of the interaction between the hadrons. The model provides good approximations for both real and imaginary parts of peripheral reaction amplitudes and successfully reproduces the differential cross sections and polarizations of $K^-p \to K^-p$ and $K^-p \to \bar{K}^0 n$ reactions for all energies ($p_{lab} \gtrsim 0.7$ GeV/c) and for all angles. (auth)

4734 THEORY OF RELATIVISTIC STRING AND SUPER-WAVE EQUATION. II. Takabayasi, T. (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto); 51: No. 2, 571-591(Feb 1974).

Theory of relativistic string in the "geometric" viewpoint is analyzed and its physical interpretation is clarified. This theory is regarded as the singular limiting case of the relativistic string theory in the "realistic" viewpoint treated in a preceding paper [T. Takabayasi, Prog. Theor. Phys. 51 (1974), 262]. If one restricts the internal motion of the realistic string theory to transversal ones alone by a certain physical constraint, both theories are smoothly connected. For this case concrete movements of relativistic string are explicitly displayed. The quantization and the introduction of the external interaction are briefly stated to indicate the meaning of relativistic string theory as a model of hadrons leading to dual amplitude. (auth)

4735 HIGH-SPIN SPINOR AND THE POLARIZATION TENSOR. Lee, C. E. (National Cheng-Kung Univ., Tainan, Taiwan). Chin. J. Phys. (Taiwan); 12: No. 1, 48-50(Apr 1974).

A relation between the high-spin spinor and the polarization tensor is proposed and proved. The explicit relation between the kinematical structures of the baryon and the boson with arbitrary spin is thus obtained. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 5104.

4736 (JINR-E2-8053) ANALYSIS OF EXPERIMENTAL DATA ON THE DIFFERENTIAL CROSS SECTION FOR ELASTIC SCATTERING USING ANALYTICITY. Chernev, Kh. M.; Dumbrais, O. V.; Zlatanov, Z. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 9p. Dep. NTIS (US Sales Only) $4.00.

The parametrization incorporating correct analytic properties of the differential cross section is used to reanalyze some recent data on π^-p, K^-p and $\bar{p}p$ elastic scattering outside the region of Coulomb interference. Extrapolation to the forward direction by means of the new expansion does not lead to values below the optical point, contrary to the results of ordinary extrapolations. Evidence was found for the increase of the slope of the differential cross section as the forward direction is approached. (auth)

4737 (JINR-P2-8165) DESCRIPTION OF THE PION DECAYS IN QUANTUM CHIRAL THEORY. Volkov, M. K.; Pervushin, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

In quantum chiral theory, in the one-loop approximation the amplitudes of the processes $\pi^{(\pm)} \to \mu^{(\pm)} \nu$, $\pi^{(\pm)} \to \gamma\gamma$, $\pi^{(\pm)} \to e^{(\pm)} \nu \gamma$ $(\mu^{(\pm)} \nu \gamma)$ and $\pi^{(\pm)} \to \pi^0 e^{\pm} \nu$ are calculated. The structure $\pi^{(\pm)} \to \mu^{(\pm)} \nu \gamma$ decay constants h_A and h_V associated with the axial and vector current contributions are expressed in terms of the $\pi^0 \to \gamma\gamma$ decay constant f and in terms of the pion polarizability in the process $\gamma\gamma \to \pi^{(+)} \pi^{(-)}$ which is in full agreement with the current algebra relations. The ratio $\gamma = h_A/h_V$ agrees with the experimental values $\gamma = 0.4$. Coupling constant renormalizations are determined as functions of the pion masses. (auth)

4738 (PURC–3072-06) PHYSICAL STATES AND POMERON POLES IN THE DUAL PION MODEL. Schwarz, J. H. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). May 1972. Contract AT(11-1)-3072. 23p. Dep. NTIS $4.25.

The methods recently developed by Brower for proving the no-ghost hypothesis for the Veneziano model with $\alpha(0) = 1$ are applied to the dual pion model. Operators are constructed that generate all the physical states, and it is proven that there are no ghosts for space-time dimensionality $d \leq 10$. In the critical dimension $d = 10$ it is found that the Pomeron singularities arising from nonplanar loops are simple poles. A new fully symmetrical model—a sort of "pionic" version of the Shapiro-Virasoro Model—is formulated and conjectured to correspond to the multi-Pomeron amplitudes. (auth)

4739 (PURC-4159-27) QUARK MODEL OF DUAL PIONS. Neveu, A.; Schwarz, J. H. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). Apr 1971. Contract AT(30-1)-4159. 11p. Dep. NTIS $4.00.

Interacting pseudoscalar pions are incorporated into Ramond's model of free dual fermions. By considering the emission of N-1 pions and factorizing in the quark-antiquark channel the same N-pion amplitudes as were proposed previously. (auth)

4740 (PURC-4159-44) DUAL PION MODEL SATISFYING CURRENT-ALGEBRA CONSTRAINTS. Schwarz, J. H. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). Oct 1971. Contract AT(30-1)-4159. 23p. Dep. NTIS $4.25.

The dual pion model, previously constructed with $m_\pi^2 = -1/2$ and $m_\rho^2 = 0$, is generalized to arbitrary pion mass while maintaining the relation $m_\rho^2 = m_\pi^2 + 1/2$. As in the conventional dual resonance model, the price for doing this is the introduction of ghosts. In the special case $m_\pi = 0$, the N-pion amplitudes are shown to possess Adler zeros, and, as a consequence, to satisfy the constraints that current algebra imposes on on-mass-shell hadron amplitudes. The axial charges are explicitly constructed and shown to close with the isospin to form the algebra of SU(2) × SU(2). This model should provide a useful theoretical laboratory for studying the consequences of combining duality and current algebra constraints. The construction of currents is a challenging problem. (auth)

4741 (RL-74-128) HOW CROSSING AFFECTS THE ANALYTIC RELATIONSHIP BETWEEN LOW ENERGY $\pi\pi$ AMPLITUDES AND THEIR ASYMPTOTIC BEHAVIOR. Pennington, M. R. (Science Research Council, Chilton (UK). Rutherford Lab.). Jul 1974. 62p. Dep. NTIS (US Sales Only) $6.25.

Different physical assumptions about the asymptotic behavior of $\pi\pi$ amplitudes are realized in the different number of subtractions involved in fixed t dispersion relations for the various amplitudes and their inverses. The fact that each new dispersion relation must be consistent with s-t crossing leads to a number of conditions relating low energy $\pi\pi$ amplitudes to their high energy behavior. These are discussed in detail. Such relations supplement finite energy sum rules with which they are compared. The dispersive sum rules, crossing conditions and finite energy sum rules discussed are applied to recent phenomenological solutions to Roy's equations and shown not to narrow the presently accepted range of threshold parameters. These results are in marked contrast to the conclusions of other recent studies. Evidence is presented to suggest that the Pomeron is late developing in meson-meson scattering. (auth)

4742 ISOSPIN-INDUCED CORRELATIONS IN A LARGE CLASS OF MODELS FOR HIGH MULTIPLICITY EVENTS. Reinders, L. J.; Ruijgrok, T. W. (Univ., Utrecht). Acta Phys. Pol.; 5B: No. 5, 695-702(1974).

Assuming that in high energy collisions only pions are produced and that the multi-pion wave function is completely symmetric in all momentum variables, bonds are derived for the different multiplicity-correlations between charged and neutral pions. It is found that in pp and in $\pi \pm p$ inelastic scattering the bound for f_{c0}, i.e., the correlation between charged and neutral pions, is violated by the experimental data. The conclusion is that the wave function cannot be fully symmetric. It is shown that with ρ-production, i.e., with an antisymmetric wave function, the observed charged-neutral correlation can be explained. (auth)

4743 $\pi\pi$ PARAMETERS FROM K_{e4} DATA AND A RIGOROUS REPRESENTATION FOR $\pi\pi$ AMPLITUDES. Tryon, E.P. (Department of Physics and Astronomy, Hunter College of The City University of New York, New York, New York 10021). Phys. Rev. D 10: No. 5, 1595-1603 (1 Sept 1974).

Previous attempts to extract the $\pi\pi$ scattering length a_0 from K_{e4} data have been handicapped by the lack of any one—parameter model for δ_0^0 which is valid over the entire energy range of the data. In this paper, we present a simple but reliable one—parameter model for the $\pi\pi$ S waves and P wave. The model is based on rigorous representations for $\pi\pi$ amplitudes, and is valid from threshold to $M_{\pi\pi} = 400$ MeV or more. We apply the model to all available K_{e4} data, and extract the value of a_0 together with the corresponding values for several other low—energy $\pi\pi$ parameters. We find that the world average of the data yields $a_0 = (0.26 \pm 0.08)\ \mu^{-1}$, in agreement with the current—algebra prediction of Weinberg. As an appendix, we present in detail the rigorous one—parameter equations for S waves and P w upon which our simple model is based. We make a precise predictior. for the $I = 2$ S wave between threshold and 900 MeV, and we predict the P wave for given values of the ρ mass and width. (auth)

4744 PHENOMENOLOGICAL, DUAL, MULTIPION AMPLITUDES. Singh, C.A.; Pasupathy, J. (Tata Institute of Fundamental Research, Bombay 400005, India). Phys. Rev. D 10: No. 5, 1655-1657 (1 Sept 1974).

The possibility of constructing N—point generalizations of the dual pion amplitude along the lines of Fairlie and Brower and Chu is explored. The difficulty of keeping simultaneously factorization and a good low—energy spectrum is discussed. (auth)

4745 PRODUCTION OF THE R, S, T, AND U RESONANCES IN THE DUAL RESONANCE MODEL. Chadha, S. (Department of Physics, McGill University, Montreal, Quebec, Canada). Phys. Rev. D 10: No. 5, 1494-1501 (1 Sept 1974).

The dual resonance model (DRM) is used to estimate the cross sections and the background for the production of narrow high—spin mesons in an idealized missing—mass (MM) experiment $a + b \to c + MM$ in which the particles a, b, and c are spinless and do not carry any internal quantum numbers. The theoretical results are compared with the recent Northeastern—Stony Brook (NU/SUNY) experiment. It is found that, while the calculated backgrounds agree reasonably well, the S, T, and U cross sections are substantially higher than their experimental upper limits obtained from this experiment. In a mathematical appendix we also present a general method for calculating N—point dual amplitudes with two external particles of arbitrary spin. (auth)

4746 DECAY $\eta' \to \eta\pi\pi$ IN THE $(6,6^*) + (6^*,6)$ MODEL OF CHIRAL—SYMMETRY BREAKING. Steiner, H. (Institut für Theoretische Kernphysik, der Universität Karlsruhe, Karlsruhe, Germany). Phys. Rev. D 10: No. 5, 1666-1668 (1 Sept 1974).

Assuming that the chiral—symmetry—breaking Hamiltonian belongs to the $(6,\bar{6}) + (\bar{6},6)$ representation of $SU(3) \otimes SU(3)$, we have estimated the width Γ of the decay $\eta' \to \eta\pi\pi$. For $I_u = 2$ an upper limit $\Gamma < 0.44$ MeV was obtained in agreement with physical expectation and with the experimental upper limit $\Gamma < 1.3$ MeV. There is no significant difference between this and the other popular models (8,8) and $(3,\bar{3}) + (\bar{3},3)$. (auth)

4747 CURRENT ALGEBRA AND RADIATIVE K^* DECAY. Watal, C.; Agarwal, B. K. (Univ., Allahabad, India). Indian J. Pure Appl. Phys.; 12: No. 3, 232-233(Mar 1974).

Radiative decay widths of the processes $K^{*+,0} \to K^{+,0}\gamma$ were predicted, using the partially conserved tensor current hypothesis and the current commutation relations. The calculations yielded values of 0.4 and 0.1 MeV for $\Gamma(K^{*0} \to K^0\gamma)$ and $\Gamma(K^{*+} \to K^- \gamma)$ respectively. (auth)

Strong (Baryon No. = 1)

4748 (ITF-74-87E) ONE-LOOP APPROXIMATION FOR THE DESCRIPTION OF πN SCATTERING IN NONLINEAR CHIRAL LAGRANGIAN. Gaisak, M. I.; Lend'el, V. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 25p. Dep. NTIS (US Sales Only) $4.25.

Description of s- and p-waves of πN-scattering in low energy region up to 400 MeV lab energy with the help of nonlinear chiral $SU(2) \times SU(2)$ Weinberg's Lagrangian is given. One-loop diagrams are calculated. In this case the number of free parameters is less by a factor of two than in the case of calculations with linear Lagrangians. These parameters are completely designed from the s-waves. In this model, therefore, one succeeds in obtaining the description of the p-waves without free parameters. Good agreement with the experiment is obtained. (auth)

4749 (JINR—D-6004, pp 85-103) MESON—NUCLEON CHARGE EXCHANGE REACTIONS. Sonderegger, P. (CERN, Geneva). 1972.

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

The four experimentally accessible meson-nucleon charge-exchange reactions $\pi^- p \to \pi^0 n$, $\pi^- p \to \eta n$, $K^- p \to \bar{K}^0 n$, $K^+ n \to K^0 p$ are discussed. The exchange degeneracy idea is checked, and the corrective terms are studied in the light of new data concerning cross sections and polarizations. Also experimental problems of interest for experiments at higher energies and some experiments in progress are discussed. Measurements on full angular distributions are quoted, and πN backward scattering is discussed. (JFP)

4750 (JINR—D-6004, pp 271-306) QUASI TWO-PARTICLE REACTIONS AT HIGH ENERGIES (NON-STRANGE PARTICLE). Gramenitskii, I. M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4751 (JINR—D-6004, pp 535-581) MODEL OF COMPLEX REGGE POLES AND HIGH ENERGY REACTIONS. Tsarev, V. A. (Lebedev Inst. of Physics, Moscow). 1972. (In Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4752 (JINR—D-6004, pp 652-704) REVIEW OF NEAR FORWARD πN SCATTERING AMPLITUDES AT HIGH ENERGIES. Hoehler, G. (Univ., Karlsruhe, Ger.). 1972.

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

The πN scattering at high energies and small momentum transfer following from experimental data and general principles as unitarity, analyticity, and charge independence is summarized. The treatment is based on recent work of the Karlsruhe group. The scattering amplitudes are mainly discussed. (JFP)

4753 (JINR—D-6004, pp 729-754) PADE APPROXIMATION FOR THE AMPLITUDE OF πN SCATTERING. Fil'kov, L. V. (Lebedev Inst. of Physics, Moscow). 1972. (In Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4754 (JINR-D1,2-7781, pp 88-125) NN AND πN INCLUSIVE REACTIONS AT HIGH ENERGIES. Sabau, M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974.

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

The discussion of NN and πN interactions at high energies covers the interaction mechanism between particles, multiplicity, one- and two-particle distributions, evidence of diffractive processes in πN and NN interactions, scaling and the approach to scaling, semi-inclusive reactions, particle correlations, and some other results from the inclusive reaction study. (JFP)

4755 (JINR-P1-8269) TWO-PARTICLE CORRELATIONS IN INCLUSIVE AND SEMI-INCLUSIVE PION–NUCLEON REACTIONS AT P = 40 GeV/c. Alma Ata-Budapest-Bucharest-Warsaw-Dubna-Kharkov-Moscow-Sofia-Tashkent-Tbilisi-Ulan Bator-Hanoi-Chandigarh Collaboration. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 25p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

Inclusive and semi-inclusive two-particle correlations were studied in terms of R-functions. With the increasing n_{ch} the structure of R-functions becomes more dominated by kinematics. The inclusive two-particle azimuthal distributions, studied under certain restrictions on rapidities and P_t of π-mesons, show long-range correlations. The data were compared with phase-space and the multiperipheral model calculations and with similar data from NAL and ISR. (auth)

4756 (RL-74-126) PHASE-SHIFT ANALYSIS OF THE REACTION $\pi^-p \to \Lambda^0K^0$. Baker, R. D. (Science Research Council, Chilton (UK). Rutherford Lab.). Aug 1974. 25p. Dep. NTIS (US Sales Only) $4.25.

The technique of Barrelet zeros was applied to perform a phase shift analysis of most of the world data on the reaction $\pi^-p \to \Lambda^0K^0$, between threshold and 2200 MeV c.m. energy. The S11(1700) and P11(1780) resonances are definitely present, and the P13 and D13 waves also resonate. The F17 wave may be resonating near 2000 MeV. The analysis of Lovelace and Wagner was checked, and that of Nelson redone using this method. No evidence is seen for a cusp in the Nelson data. (auth)

4757 (UCRL-20030-pi-N) π N PARTIAL-WAVE AMPLITUDES. A Compilation. Herndon, D. J.; Barbaro-Galtieri, A.; Rosenfeld, A. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1970. 91p. Dep. NTIS $7.75.

A collection of the results of ten partial-wave analyses performed on the elastic π^+p and π^-p scattering from 0 to 2 GeV/c incident momentum is presented. The amplitudes and various parameters deduced from the amplitudes are plotted and tabulated. Only results are reported. It is noted that it is useful to be able to compare all ten solutions for at least two reasons: to see if a resonance is present and if so what its parameters might be and to get some idea of the external errors of the solutions. (JFP)

4758 LEGENDRE PADE APPROXIMANTS IN πN SCATTERING. Engels, J.; Fleischer, J. (Univ., Bielefeld, Ger.). Nuovo Cim.; 24A: No. 1, 73-92(1 Nov 1974).

Padé approximants are expected to probe the singularity structure of scattering amplitudes. Padé approximants are applied for Legendre series to πN amplitudes, which are obtained from phase shifts. The imaginary parts were calculated from the phase-shift analysis of Almehed and Lovelace, the real parts from fixed-*t* dispersion relations directly and from the phase-shift analysis of Nielsen and Oades. For all amplitudes (except for the isospin-odd Nielsen-Oades) the poles of the Padé approximants are outside the region of analyticity in the Mandelstam plane. The Padé approximants and the truncated Legendre series for the imaginary parts deviate from each other only up to 1% even close to the boundary of the double-spectral function (except for $B^{(+)}$). (auth)

4759 q^2 INDEPENDENCE OF THE F/D RATIOS IN MATRIX ELEMENTS OF THE AXIAL–VECTOR CURRENTS BETWEEN BARYON OCTET STATES. Eimerl, D. (Department of Physics, University of California, San Diego, La Jolla, California 92037). Phys. Rev. D 10: No. 5, 1550-1553 (1 Sept 1974).

The F/D ratios of the pseudovector and pseudoscalar form factors in the matrix elements of the axial–vector currents between baryon octet states are shown to be almost independent of q^2 over a large range in q^2, at least $q^2 < 4\ \text{GeV}^2$, timelike. Evidence is presented to indicate that this behavior persists to much higher values of q^2. The smoothness of these ratios is related to the pseudoscalar-meson-baryon coupling f/d ratio, independent of q^2 occurring for $(f/d)^2 = 5/9$. (auth)

4760 UPPER AND LOWER BOUNDS FOR THE SUM OF π^+p AND π^-p TOTAL CROSS SECTIONS AT HIGH ENERGY. Craver, B.; Tubis, A. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). Phys. Rev. D 10: No. 5, 1646-1649 (1 Sept 1974).

Upper and lower bounds for weighted integrals of $2\sigma_s = \sigma_{tot}(\pi^+p)+\sigma_{tot}(\pi^-p)$ at pion laboratory energies $\omega > 60$ GeV are derived in terms of available experimental data and assumed bounds on the phase of $T_s(\omega)$, the πp crossing–symmetric forward scattering amplitude above 20 GeV. The bounded integrals are of the form $\int^{M}_{M_1} \sigma_s(\omega)K(\omega)d\omega$ with $60\ \text{GeV} \leq M_1 < M$, and $K(\omega) \sim \omega^{-\gamma}(1<\gamma<1.72)$ as $\omega \to \infty$. Our analysis also gives an upper bound on σ_1, the minimum of the phase of $T_s(\omega > 60\ \text{GeV})$. (auth)

4761 ISOTOPIC SPIN CONSERVATION AND CHARGE DISTRIBUTION IN MULTIPION PRODUCTION. Moshinsky, M.; Patera, J. (Centre de Recherches Mathématiques, Université de Montréal, Montréal, P. Q., Canada); Sharp, R.T.; Winternitz, P. Phys. Rev. D 10: No. 5, 1587-1594 (1 Sept 1974).

A general reaction of the type $A+B \to C+N\pi$ is considered in which the final N pions are produced in a state with definite isospin T and charge q. Rigorous bounds on the ratio Γ (N, q, T) of the number of neutral to the number of charged pions are derived, following from isospin invariance and Bose statistics alone. Previously known results are recovered for T = 0 and 1 and new bounds are obtained for T = 2 and 3. The N–pion state with fixed T is appropriately symmetrized using the representation theory of SU(3) in an O(3) basis. We can deal with arbitrary values of T, since we have resolved the $SU(3) \supset O(3)$ missing–label problem. An example of the type of bounds we obtain is for the reaction $\pi^+ + p \to n + N\pi$, where $T = q = 2$. For $N \geq 4$ and even, we obtain $(N-2)/(6N+2) \leq \Gamma \leq \{7N+2[(2N-1)^2-8(N-4)]^{1/2}\}/\{14N-2[(2N-1)^2-8(N-4)]^{1/2}\}$. Similar results are given for N odd and also for T = 3 reactions like $\pi^+ + p \to \Delta^- + N\pi$. (auth)

4762 ANGULAR MOMENTUM COMPOSITION OF THE PROTON IN THE QUARK–PARTON MODEL. Sehgal, L.M. (III. Physikalisches Institut, Technische Hochschule Aachen, Aachen, West Germany). Phys. Rev. D 10: No. 5, 1663-1665 (1 Sept 1974).

Assuming the angular momentum of a polarized proton $(J_z=1/2)$ to be the resultant of the total spin S_z and total momentum L_z of its parton constituents (quarks and antiquarks), we find $S_z=1/2(3F-D)$, $L_z=1/2(1-3F+D)$. The approximation employed is the same as that leading to the Ellis–Jaffe sum rules for polarized electron–nucleon scattering. The result for L_z, interpreted geometrically, implies that a polarized proton possesses a significant amount of rotation. On the assumption that S_z and L_z are dominated by ρ and Π quarks, an estimate is made of the separate contribution of these constituents. (auth)

4763 DETERMINATION OF THE Δ (1236) POLE POSITION. Spearman, T.D. (School of Mathematics, Trinity College, Dublin, Ireland). Phys. Rev. D 10: No. 5, 1660-1662 (1 Sept 1974).

A procedure is described for determining the position of a second–sheet resonance pole. This method is not model–dependent in the sense that it does not require the use of a resonance formula or other parametrization of the resonant phase shift. The method is applied to the Δ (1236) resonance where the pole position in the W plane is found to be 1213 − 49i MeV. (auth)

4764 THE QUANTUM ELECTRODYNAMICS OF THE NUCLEON. Williams, R.C. II (London House, Mecklenburgh Sq., W.C.1, London, England). Ann. Phys. (N.Y.) 87: No. 1, 126-160 (Sept 1974).

The Nuclear Force between a statistical assemblage of nucleon pairs is calculated directly for pseudo–scalar meson exchange. The Nucleon (proton) is treated as a particle with an extended structure. The model of the proton used is the one determined by high energy electron–proton scattering experiments. The self–energy process for such a proton is examined first for the emission and re–absorption of a photon. An appropriate photon propagator is derived for such a system using variational techniques. It is shown that the integrals that occur in the self–energy process converge without any of the difficulties associated with the point charge model. This shows the divergences in Quantum Electrodynamics (for nucleons) do not exist when nucleons are treated as particles with a structure. The pseudo–scalar meson propagator is derived using similar methods and the exchange force is calculated. It is shown that only certain diagrams need be considered when a stable nuclear bond is being calculated. The corrections to the Nuclear Force, which are self–energy processes involving emission and re–absorption of Virtual pseudoscalar mesons, are shown to converge for strong coupling. (auth)

4765 SUM RULE FOR PHASES IN πN- AND KN-SCATTERING AT HIGH ENERGIES. Zamiralov, V. S. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 4, 496-499(1974). (In Russian).

As a result of significant progress in amplitude analysis of πN- and kN-scattering, by means of reasonable assumptions it is possible to relate definite contributions to the amplitude with measured values. For example, the imaginary part of the ω-contribution is proportional to the difference of differential cross sections of elastic $k^{\pm}p$-scattering, while the real part amplitude with spin reversal in the πN-charge transfer reaction can be expressed by a difference in polarization $p^{\pm}$ of elastic $\pi^{\pm}p$-scattering. In both cases it is assumed that the amplitude with spin reversal can be neglected in elastic scattering. Relations are obtained between phases of amplitudes in πN- and kN-scattering and also between polarization parameters in this study. The results from the sum rule for πN-scattering are tabulated. Similar formulas are used in kN-scattering. Thus the small value of elastic amplitudes with spin reversal made it possible to find a simple sum rule for phases and to obtain relations between measured values in a model-independent manner. (SJR)

4766 DUAL MODEL WITH NON-DEGENERATE PARITY PARTNERS AND PION–NUCLEON BACKWARD SCATTERING. Hirose, K. (Osaka Univ., Toyonaka, Japan). Progr. Theor. Phys. (Kyoto); 51: No. 3, 823-839(Mar 1974).

A model of πN scattering with the nonlinear baryon trajectories is investigated in terms of modified beta-functions. Dual representations are given incorporating the nonlinear baryon trajectories in the generalized scheme of Volkov and Radchenko. The hypothesis that the $D_{33}(1670)$ is the MacDowell partner of the $P_{33}(1236)$ is assumed as the input to the theory, and it is shown that this hypothesis leads to the reasonable agreement with the experimental data, both for the forward and backward differential cross sections. (auth)

4767 ISOBAR MODEL PARAMETERS OF THE FIRST PION–NUCLEON RESONANCE. de Baenst-Vandenbroucke, A. (Univ., Louvain, Belg.); de Baenst, P. Ann. Soc. Sci. Brux. Ser. I; 88: No. 3, 326-340(1974).

It is shown that (1) the standard identifications of the M_{Δ} of the first isobar with the energy where the δ_{33} phase shift passes through 90° ($M_0 = 1231$ MeV) and of its decay rate $\Gamma = \Gamma(\Delta \to N_{\pi})$ with the total width at the resonant energy (.$\Gamma_0 = 111$ MeV) do not only lead to unsatisfactory predictions for the P_{33} amplitude of πN scattering but are also inconsistent in so far as these assignments amount to ignoring the important Born contribution present in the isobar model; (2) the values of M_{Δ} and Γ consistent with the Born contribution are 1221 and 90 MeV respectively; (3) with these values for the $\Delta^{+}_{\frac{3}{2}}$ parameters, the isobar model consisting of the Born- and Δ-contributions alone is capable of reproducing to a very good approximation the P_{33} amplitude over the entire range of the first resonance region. (auth)

4768 PERIPHERAL RESONANCE PRODUCTION IN THE INCLUSIVE REACTION. Myozyo, Y. (Higashi Junior Coll., Kitakyushu, Japan). Progr. Theor. Phys. (Kyoto); 51: No. 3, 859-864(Mar 1974).

Exotic exchange processes, i.e., $\pi^{\pm}p \to \pi^{\pm}X$, are investigated in the large x region, using the resonance production with the ordinary exchange. For the $\pi^{\pm}p \to \pi^{\pm}X$ processes, $(\pi^{\pm}\pi^{\pm})$ resonances and pion exchange are assumed to be dominated. At low energies experiments are not fully explained by this model, but at high energies results are in good agreement quantitatively. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 4799 and 5012.

4769 (BNL–18027) CALCULATION OF PION YIELD DISTRIBUTIONS BY KINEMATIC REFLECTION. Blumberg, L.; Kanofsky, A. (Brookhaven National Lab., Upton, N. Y. (USA)). 10 Jul 1973. 24p. Dep. NTIS $4.25.

The angle and momentum dependence of the yield $Y = d^2N/d\Omega dp$ of low energy negative pions produced in high energy nucleon-nucleon interactions was computed by kinematic reflection of the Sanford-Wang formula. The angular distributions are not forward-peaked (Y_{max} at $\theta \approx 20°$ for $p_{\pi} = 200$ MeV/c from 28 GeV/c protons), in agreement with previous results of C. L. Wang. For 12 GeV/c protons, the calculated forward yield of 500 MeV/c π^- is twice the value measured at the ZGS by G. Marmer. (auth)

4770 (JINR–D-6004, pp 104-116) CHARGE EXCHANGE REACTIONS NP → PN AND $\overline{P}P \to \overline{N}N$. Schopper, H. (CERN, Geneva). 1972.

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

The t-dependence of np → pn charge exchange and $\overline{p}p \to \overline{n}n$ interactions is considered. The parameters deduced from the fits are presented as a function of energy. (JFP)

4771 (JINR-D1,2-7781, pp 126-149) MULTIPARTICLE PRODUCTION PROCESSES IN HADRON–HADRON COLLISIONS AT HIGH ENERGY. Ranft, J. (Karl-Marx-Univ., Leipzig). 1974.

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

The discussion of multiparticle processes in hadron–hadron collisions at high energies covers rising total cross sections, and inclusive two-particle correlations. (JFP)

4772 (JINR-D1,2-7781, pp 263-277) CORRELATIONS IN THE UNCORRELATED JET MODELS FOR pp INTERACTIONS. Wojcik, W. 1974.

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

In order to study the correlations between the secondary π^- mesons correlation coefficients were introduced. Results are given for the evaluation of the inelastic charged multiplicity distribution for pp interactions at 69 to 303 GeV/c. (JFP)

4773 (JINR-D1,2-7781, pp 278-289) ELASTIC pp AND pd SCATTERING IN THE REGION OF COULOMB INTERFERENCE IN THE ENERGY REGION FROM 500 TO 1000 MeV. Vorob'ev, A. A.; Zalite, Yu. K.; Korolev, G. A.; Korolev, V. A.; Maev, E. M.; Medvedev, V. I.; Sokolov, G. L.; Shchegel'skii, V. A. (Inst. of Nuclear Physics, Leningrad). 1974. (In Russian).

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

4774 (LA-5729-MS) SCATTERING PHASE SHIFTS FOR THE COULOMB PLUS SEPARABLE POTENTIAL PROBLEM. Griffy, T. A.; Gibbs, W. R.; Gibson, B. F. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1974. Contract W-7405-eng-36. 5p. Dep. NTIS $4.00.

An expression for the phase shift arising in the scattering of two nonrelativistic charged particles which interact through a separable potential is derived. A relation between the charged and neutral (Coulomb corrected) scattering lengths is deduced for a simple Yamaguchi potential. It is verified that Coulomb corrections to the p-p scattering length are large and model dependent. It is argued that Coulomb corrections to the π^+-p scattering length are small and model independent. (auth)

4775 DESCRIPTION OF COHERENT PION PRODUCTION WITH A GENERALIZED VENEZIANO MODEL. Tavernier, S. (Inter-University Inst. for High Energies, Brussels). Nuovo Cim.; 24A: No. 1, 99-110(1 Nov 1974).

If one uses the impulse approximation, the amplitudes for the reactions $K^+d \to K^0\pi^+d$ and $K^-d \to \overline{K}^0\pi^-d$ can be expressed as a function of the amplitudes of the corresponding reactions on a free neutron and a free proton. These neutron and proton reactions are related through crossing, and the same Veneziano amplitude can be used for them. This is an interesting test of the model since pion exchange is forbidden in these reactions, and the result depends on the relative phase of the neutron and proton amplitudes. A fair description of both coherent reactions is obtained. (auth)

4776 DUALITY STRUCTURE OF DIFFRACTION DISSOCIATION. Hidaka, K. (Tokyo Univ.). Lett. Nuovo Cim.; 11: No. 10, 503-507(9 Nov 1974).

It is determined in more detail whether the experimental data favor the normal or abnormal duality scheme by the triple-Regge analysis of the recent high energy inclusive data on pp → pX interactions. It is found that previous abnormal duality schemes are ruled out by this analysis at least in the interval $0.15 \lesssim t \lesssim 0.4$ $(GeV/c)^2$. But the normal duality scheme is quite compatible with the experimental data in the same t region, though the possibility of the mixed duality suggested previously is not excluded. (JFP)

4777 PROTON–PROTON TOTAL CROSS SECTION ABOVE 10^4 GeV: CAN COSMIC RAYS GIVE THE ANSWER? Berger, V.; Halzen, F. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706); Gaisser, T.K.; Noble, C.J.; Yodh, G.B. Phys. Rev. Lett. 33: No. 17, 1051-1054 (21 Oct 1974).

From Glauber calculations of the absoprtion cross section of nucleons on air (σ_{abs}) we find that present extensive–air–shower data cannot resolve the question of the asymptotic energy behavior of the nucleon–nucleon total cross section [σ_t(NN)]. Relative differences between various asymptotic extrapolations for σ_t(NN) are reduced by about a factor of 3 in σ_{abs} through the Glauber conversion. Novel techniques or convectional experiments with a better determination of electron and muon numbers in extensive air showers will be required in order to obtain useful information on proton–proton cross sections in the asymptotic region. (auth)

4778 THEORETICAL ANALYSIS OF MULTIPARTICLE PRODUCTION ON NUCLEI AT HIGH ENERGY. Calucci, G.; Jengo, R. (Istituto di Fisica Teorica dell'Università, Trieste, Italy and Istituto Nazionale di Fisica Nucleare, Sezione di Trieste, Italy); Pignotti, A. Phys. Rev. D 10: No. 5, 1468-1471 (1 Sept 1974).

The multiplicity distribution of shower particles from emulsion exposures at a 200–GeV/c proton beam at NAL is analyzed using Gottfried's model. The data give information on the value of a fundamental parameter of the model. (auth)

4779 SHIFT OF PEAKS AND DIPS IN ELASTIC SCATTERING IN THE CHOU–YANG MODEL. Clarke, D.J.; Lo, S.Y. (School of Physics, University of Melbourne, Parkville, Victoria, Australia 3052). Phys. Rev. D 10: No. 5, 1519-1526 (1 Sept 1974).

The effect of the logarithmic increase of total cross section of the pp interaction on the Chou–Yang model is investigated. It is found that (i) the positions of dips and peaks move inward towards smaller $|t|$ values as the energy increases and (ii) the height of the peaks increases logarithmically as a function of energy. Comparison with the model of Cheng and Wu is made. (auth)

4780 TWO–PION CORRELATIONS IN THE DIFFRACTIVE EXCITATION MODEL. Kasman, J. (Physics Department, Westfield College, University of London, London, England). Phys. Rev. D 10: No. 5, 1632-1642 (1 Sept 1974).

The diffractive excitation model (DEM) is formulated in terms of rapidity, and used to calculate the inclusive rapidity distributions $pp \to \pi^- X$ and $pp \to \pi^- \pi^- X$. Using simplified kinematics, analytic calculations are made for these distributions and the related multiplicity moments. The two–pion correlations in the isotropic–decay model are found to be in agreement with experiment at low energies, but rise too rapidly with energy, lying an order of magnitude above Intersecting–Storage–Rings data. A modified DEM, with longitudinal decay of the diffractive cluster, accounts for the size and weak energy dependence of correlations in the diffractive part of the inelastic cross section. This model is found suitable for use as the diffractive component in a two–component model. (auth)

4781 RELATIONS BETWEEN THE HYPERSPHERICAL HARMONIC AND THE HARMONIC OSCILLATOR METHODS FOR THE THREE BODY PROBLEM. Chacon, E.; Levi, D.; Moshinsky, M. (Universidad Nacional de Mexico, Mexico City). Rev. Mex. Fis.; 22: No. 4, 291-319(1973).

A systematic and explicit-procedure is given for deriving hyperspherical harmonics for the three body problem with given permutational symmetry. The matrix elements of a two body interaction with respect to these hyperspherical harmonics are determined in terms of the corresponding ones for harmonic oscillator states. This allows one to reduce the three body problem to a system of coupled ordinary differential equations for the hyperradial functions. (auth)

4782 CONSERVATION OF SPIN AND AZIMUTHAL CORRELATIONS DURING THE COHERENT DIFFRACTION DISSOCIATION $\pi \to 3\pi$. Azimov, S. A.; Abduzhamilov, Sh.; Eroshkina, N. B.; Saidkhanov, N. Sh.; Chudakov, V. M. (Physical-Technical Inst., Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 4, 52-54(1974). (In Russian).

On the assumption of spin conservation, the azimuthal correlations were calculated in the reaction $\pi^- A \to A\pi^-\pi + \pi^-$ at 17.2 GeV/c. Experimental data agree with the results of the calculation. (SJR)

4783 FINAL-STATE INTERACTION AND COMPOSITION OF SECONDARY PARTICLES. Shuryak, E. V. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz.; 20: No. 3, 549-553(Sep 1974). (In Russian).

Extension of ideas of the Pomeranchuk statistical model to the case of the collision at high energies is discussed. The transversal momentum distribution of the secondary particles and their composition are considered. It is shown that the obtained relation between these characteristics is valid also in the region of high transverse momenta. (auth)

4784 PHENOMENOLOGICAL ANALYSIS OF THE PIONIZATION PROCESS ON THE BASIS OF THE UNCORRELATED-JET MODEL. II. Toda, A. (Tohoku Univ., Japan). Sci. Rep. Tohoku Univ., Fifth Ser.; 56: No. 4, 143-151(Dec 1973).

The uncorrelated-jet model is presupposed for the exclusive reaction $N + N \to N + N + n\pi$. Various moments and distributions in inclusive reactions are then derived from this model. Numerical values of these expressions are compared with the experimental data of inelastic pp-collisions in the energy range 20 to 1000 GeV. As a result of this analysis the merits and demerits of the uncorrelated-jet model are discussed. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 4644, 5118, and 5123.

4785 (ITF-74-72E) TENSOR PRODUCT OF REPRESENTATIONS OF SEMISIMPLE LIE GROUP. II. Klimyk, A. U. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

The problem of the tensor product of finite-dimensional and elementary infinite-dimensional representations of semisimple Lie group decomposing into topologically irreducible representations is considered. The topologically irreducible representations involved in this tensor product are defined. (auth)

4786 (ITF-74-100P) IRREDUCIBLE REPRESENTATIONS OF THE CONFORMAL GROUP. I. The Action Formula of the Lie Algebra Elements. Golod, P. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 27p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The action formulas of the Lie algebra of the group SU (2.2) in the space of its elementary representation are obtained. (auth)

4787 CP VIOLATION AS A QUANTUM EFFECT. Georgi, H. (Lyman Laboratory, Harvard University, Cambridge, Massachusetts 02138); Pais, A. Phys. Rev. D 10: No. 4, 1246-1250 (15 Aug 1974).

For gauge theories with perturbative spontaneous symmetry breakdown it may happen that the question of CP invariance is solely settled by the structure of the quantum corrections to the classical scalar potential. It is shown that this can occur if and only if there exist spinless bosons which are massless in the tree aproximation and which are non-Goldstone modes. This can be achieved in a natural way (in the technical sense) if an accidental symmetry is present. The general theorem is illustrated with a few formal examples, some of which yield CP invariance and some CP violation. Our theorem also implies that if the leading radiative corrections opt for CP invariance, then the theory is CP–invariant to all orders. Our examples further reveal the possibility that some gross features of the particle spectrum may also be solely determined by quantum effects. (auth)

4788 CONFORMAL INVARIANCE AND HELICITY CONSERVATION IN SPINOR–SPINOR SCATTERING. Chan, F.; Jones, H.F. (Physics Department, Imperial College, London SW7, England). Phys. Rev. D 10: No. 4, 1356-1357 (15 Aug 1974).

We investigate, in spinor–spinor scattering, the extent to which a connection established for lower spins between conformal invariance and helicity conservation generalizes to higher spins. The result is that helicity is conserved, with the exception, however, of the compensating helicity–flip amplitude $T_{1/2,1/2;-1/2,1/2}$, which survives subject only to a differential constraint. (auth)

4789 COMMENT ON THE ANALOGY BETWEEN CHIRAL–SYMMETRY BREAKDOWN AND SUPERCONDUCTIVITY. Lane, K. (Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. D 10: No. 4, 1353-1355 (15 Aug 1974).

Fermion masses resulting from dynamical breakdown of chiral symmetry in a renormalizable field theory are shown to have an essential singularity at vanishing coupling constant, just as does the energy gap in a superconductor. (auth)

4790 SUPERGAUGE TRANSFORMATIONS AND THE DISCRETE-SYMMETRY TCP. Hruby, J. (Nuclear Research Inst., Rez, Czech.). Lett. Nuovo Cim.; 11: No. 8, 437-440(26 Oct 1974).

Recently the supergauge transformations were introduced and the properties of this transformation were further studied, because the supergauge symmetry may be looked up as the first example of unitary and relativistic spin-containing theory. Restriction is made to the 14-parameter subalgebra of the Wess–Zumino system. It is found that the scalar superfield which is tested under the operation of discrete symmetry CPT gives an interesting restriction on the 16-component set of ordinary fields in four dimensions. (JFP)

4791 CPT-COVARIANCE: PHYSICAL MEANING OF A NEW DERIVATION. Mignani, R. (Univ., Rome); Recami, E. Lett. Nuovo Cim.; 11: No. 8, 421-426(26 Oct 1974).

It is shown that the PT Lorentz transformation results actually are the CPT operation so that CPT is nothing but a particular physical generalized Lorentz transformation. Also the physical meaning of charge conjugation C is clarified in terms of only pure operations on four-momentum space, the connection particle–antiparticle, and so on. According to this analysis, it is concluded that since -1 = CPT both for bradyons and tachyons under the GLT strong reflection the particles in the initial state of an interaction process will be transformed into antiparticles in the final state of the same interaction process and vice versa. (JFP)

4792 LOOP APPROXIMATION AND SPONTANEOUS SYMMETRY BREAKING. Batalin, I. A.; Tyutin, I. V. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 20: No. 3, 569-575 (Sep 1974). (In Russian).

It is shown that the loop approximation in the theories with spontaneous symmetry breaking, proposed previously, is self-consistent only in the Higg's model. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstract 4702.

4793 (JINR-D1,2-7781, pp 378-389) BREAKDOWN OF CP INVARIANCE. Valuev, B. N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

4794 GENERALIZED CURRENT ALGEBRA INCLUDING FIRST– AND SECOND–CLASS CURRENTS. Stremnitzer, H. (International Center for Theoretical Physics, Trieste, Italy). Phys. Rev. D 10: No. 4, 1327-1339 (15 Aug 1974).

The total weak $\Delta S = 0$ hadronic current is usually split into CP–odd and CP–even, or first– and second–class currents. It is postulated that these currents obey an (SU(2) ⊗ SU(2)) ⊗ (SU(2) ⊗ SU(2)) algebra. This implies a set of Adler–Weisberger relations which, in particular, indicate the coupling of weak leptonic $\eta \to \pi l \nu$ decay as being of order one. It is possible to consider the strong interactions approximately invariant under the group generated by all these currents by introducing an additional set of scalar Goldstone bosons as well as C–odd pseudoscalar mesons. Since the latter seem not to exist, one has an alternative realization by CP doublets. As a special example, a generalized σ model is discussed. Further consequences are partial conservation of vector current and Goldberger–Treiman-type equations. Finally, the extension of the full algebra to leptons is discussed, which suggests the interesting fact that electrons and muons are CP partners of each other and the separate conservation of electron and muon numbers is a consequence of CP conservation. (auth)

4795 COMMENT ON THE OCTET RULE IN THE GEORGI–GLASHOW MODEL WITH HAN–NAMBU QUARKS. Morris, E. (Department of Theoretical Physics, University of Oxford, Oxford, England); Scharbach, P.N. Phys. Rev. D 10: No. 4, 1361-1365 (15 Aug 1974).

We show that a cancellation mechanism proposed by Kingsley to generate the octet rule in three–triplet theories cannot be realized in the model of Georgi and Glashow. It is incidentally found that, in this model, the mass of the intermediate vector boson is double–valued; $\theta_C = 13.3°$ implies $M_W = 34.6$ or 36.7 GeV. (auth)

4796 CHARMED PSEUDOSCALAR–MESON MASSES IN BROKEN SU(4) X SU(4) SYMMETRY. Prasad, S.C. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 10: No. 4, 1350-1352 (15 Aug 1974).

In the broken SU(4) × SU(4) model the possibility that the charmed pseudoscalar mesons can acquire heavy masses compared to the known particles is investigated. Solution for a symmetry–breaking parameter crucial to the model is obtained. It is shown that the masses of the charmed pseudoscalar mesons are of the order of 1 GeV if both SU(3) and SU(2) × SU(2) are good symmetries of the Hamiltonian. (auth)

4797 UNIFIED WEAK AND ELECTROMAGNETIC GAUGE THEORY BASED ON SU(3) ⊗ U(1). Gupta, V. (Tata Institute of Fundamental Research, Colaba, Bombay–400005, India); Mani, H.S. Phys. Rev. D 10: No. 4, 1310-1314 (15 Aug 1974).

A gauge theory based on SU(3) ⊗ U(1), unifying weak and electromagnetic interactions of leptons and hadrons, is presented. The leptons and the hadronic quarks enter in a completely symmetric manner in the model. The $\Delta S = 1$ weak interactions arise from the spontaneous breaking of the gauge symmetry. The model has no undesirable interactions. It is also pointed out that the model is free from anomalies and so is expected to be renormalizable. (auth)

4798 RENORMALIZABLE GAUGE THEORIES WITH NONLINEAR CONSTRAINTS. MacDowell, S.W. (Physics Department, Yale University, New Haven, Connecticut 06520). Phys. Rev. D 10: No. 4, 1289-1291 (15 Aug 1974).

We discuss a class of gauge theories with nonlinear constraints which are equivalent to renormalizable theories with gauge groups of the form $G \otimes G'$ in the limit as one of the charges vanishes. Such theories may be useful in obtaining natural zeroth–order symmetries without introducing strangeness–carrying neutral currents. (auth)

4799 SCALING AND THE APPROACH TO SCALING AT LARGE TRANSVERSE MOMENTUM. Barnett, R.M.; Silverman, D. (Department of Physics, University of California, Irvine, Irvine, California 92664). Phys. Rev. D 10: No. 5, 1510-1518 (1 Sept 1974).

Large transverse–momentum scaling as $E d\sigma/d^3p = p_\perp^{-8} f(x_\perp, x_\parallel)$ is first discussed in terms of models of parton–parton scattering. We review explicitly the equivalence of this approach to the multiperipheral and field–theory approaches, and we find the parton distribution function that fits the recent CERN ISR and NAL data. Then the deviations from scaling at nonasymptotic energies due to internal and external masses are examined by an exact numerical calculation of the general peripheral structure for the single–particle spectrum, which includes the parton models. This provides good fits to the single–particle spectra at all $p_\perp$ and explains the observed deviations from scaling at small $p_\perp$. The rise of the central plateau, secondary trajectories, and particle ratios at large $p_\perp$ are also discussed. (auth)

Applications (Strong)

Refer also to abstracts 4722, 4746, and 4812.

4800 CHIRAL SU(4) ⊗ SU(4) AND THE DECAY $X \to \eta\pi\pi$. Deshpande, N.G.; Dicus, D.A. (Center for Particle Theory, University of Texas at Austin, Austin, Texas 78712). Phys. Rev. D 10: No. 5, 1613-1618 (1 Sept 1974).

We calculate the decay rate for the process $X \to \eta\pi\pi$ in a chiral SU(4) ⊗ SU(4) model. The presence of two $I = 0$, $Y = 0$ Goldstone particles in the symmetry limit allows us to extend partially conserved axial–vector current to both η and X fields. The rate is calculated purely in terms of the symmetry–breaking parameters of the model, under the assumption that the symmetry is broken by the $(4^*, 4) \oplus (4, 4^*)$ representation. We find that the calculated rate is well below the expected experimental rate for reasonable values of the symmetry–breaking parameters. (auth)

Scattering Theory

Refer also to abstract 5100.

4801 (COO-3235-44) UNITARITY MODIFICATIONS OF THE COUPLED CHANNEL T AND K OPERATOR EQUATIONS FOR MANY-BODY SCATTERING. Kouri, D. J.; Levin, F. S. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F.R. Germany); Brown Univ., Providence, R. I. (USA). Dept. of Physics). 1974. 3p. (CONF-740822-5). Dep. NTIS $4.00.

From conference on few body problems in nuclear and particle physics; Quebec, Canada (27 Aug 1974).

Modifications in the recently proposed coupled-channel T and K operator equations describing many-body scattering are discussed. The analysis is based on a careful examination of the discontinuity equation for the matrix of channel resolvent operators g(Z) and also on the use of Cauchy's theorem to relate real and imaginary parts of g(Z). In the original equations, $g_{ij}(Z) = \sigma_{ij} G_j(Z)$, where $G_j = (Z - H_j)^{-1}$ and H_j is the jth channel Hamiltonian. The change involves the replacement $g(Z) \to \tilde{g}(Z)$, with $\tilde{g}_{ij}(Z) = g_{ij}(Z)P(j)$, where P(j) projects only on to the bound internal states in channel j. As a consequence, only bound internal states in each channel need be used as an expansion basis for solving many-body scattering problems, except in the free-particle channel ($j = 0$), where n-body plane wave states are required. (auth)

4802 (DESY-74/36) LARGE MOMENTUM BEHAVIOR OF THE FEYNMAN AMPLITUDES IN THE PHI$^4_4$-THEORY. Pohlmeyer, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1974. 31p. Dep. NTIS (US Sales Only) $4.75.

The complete asymptotic expansion of the Feynman amplitudes for large values of the scale parameter is derived in the ϕ^4_4-theory for Euclidean and Minkowski metrics. (auth)

4803 (ITF-74-47E) TOPOLOGICAL PROPERTIES OF LANDAU CURVES IN CONNECTION WITH THE MANDELSTAM HYPOTHESIS. Enol'skii, V. Z. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 23p. Dep. NTIS (US Sales Only) $4.25.

Within perturbation theory, the Feynman amplitude F_G associated with the Feynman graph G is considered for a scalar scattering reaction of the $1 + 2 \to 3 + 4$ type. The sufficient conditions of the Mandelstam hypothesis validity are found as conditions on Landau curves L_G for the amplitude F_G, $G \epsilon A$ where A is some class of Feynman graphs singled out. The application of the obtained criterion to the ladder graphs is considered. (auth)

4804 (ITF-74-84P) LORENTZ ANALYSIS OF DUAL ANALYTIC MODEL. Bugrii, A. I.; Kobylinskii, N. A.; Likhachev, A. A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

An analysis of the decomposition of a dual analytic model according to the representations of the group (3, 1) is carried out. Restrictions imposed by duality on the structure of Lorentz singularities as well as the transition to the narrow resonance limit are discussed. (auth)

4805 (ITF-74-88P) NEW INTEGRAL EQUALITIES FOR SCATTERING AMPLITUDE. Lomsadze, Yu. M.; Kelemen, V. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 11p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Two types of new integral equalities for scattering amplitude are obtained. One type of equalities allows one to define experimentally the physical coupling constant g, another one can serve as the immediate experimental verification of the quantum field theory principles. All integrals are understood in the usual sense rather than in the sense of principal value and owing to a damping-function they are effectively cut in the arbitrarily chosen finite energy region. (auth)

4806 (JINR-D-6004, pp 755-768) METHOD OF COHERENT STATES AND DIAGRAM TECHNIQUES FOR DUAL AMPLITUDES. Kvinikhidze, A. N.; Markovski, B. L.; Popov, Kh. D.; Stoyanov, D. Ts.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

4807 (KFKI-74-59) GENERALIZATION OF THE PHASE EQUATION TO INCLUDE THE ZERO-ENERGY LIMIT. Dolinszky, T. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

The cut-off procedure which leads to the usual phase equation consists in introducing a set of auxiliary problems by the complete truncation of the physical potential outside a moving distance. The phase equation obtained in this way ceases to have any meaning at zero energy and loses applicability at the smallest energies. A generalization of the cutoff procedure by keeping the auxiliary potentials in the external region at a constant but nonzero level seems to imply the possibility of deriving a new type of phase equation which works equally well for zero and nonzero energies. (auth)

4808 (PURC-4159-21) LAPLACE TRANSFORM DIAGONALIZATION OF FORWARD SCATTERING ABSORPTIVE PART EQUATIONS. Abarbanel, H. D. I.; Saunders, L. M. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). [nd]. Contract AT(30-1)-4159. 42p. Dep. NTIS $5.25.

A Laplace transform procedure is presented for the partial diagonalization of Bethe-Salpeter like absorptive part equations for the forward scattering of spinning particles. By using Laplace transforms the analysis allows directly for power growth in energy of the absorptive parts of the amplitude without any need for the analytic continuations required in a Fourier analysis. The integral equation with an arbitrary kernel is explicitly diagonalized, resulting in a reduction from a set of four dimensional equations to coupled one dimensional equations. As a tool for locating the proper definitions of partial wave amplitudes and for deriving a crucial addition theorem, the necessary representation theory of the little group for forward scattering, SO(1,3), is described. (auth)

4809 APPROXIMATIVE METHOD FOR COMPUTING CROSS SECTIONS. Rayski, J. (Jagellonian Univ., Krakow). Acta Phys. Pol.; 5B: No. 5, 631-643(1974).

An approximative method consisting in combining the procedure of iteration with the best fit of a free parameter is discussed. This method is shown to be particularly simple and exact in a wide range of values of the coupling constant. It deserves to be called a "refined Born approximation". The problem of transition from the case of scattering on an external potential to the case of a mutual scattering of two particles is discussed anew. (auth)

4810 THREE-DIMENSIONAL LAGRANGIAN FORMULATION OF THE CLASSICAL RELATIVISTIC TWO-BODY PROBLEM. Gaida, R. P. (Lvov State Univ.). Acta Phys. Pol.; 5B: No. 5, 613-629(1974). (In Russian).

The consistency of the three-dimensional Lagrangian formalism in the classical relativistic two-body problem was considered. Transformation formulas corresponding to the infinitesimal Lorentz transformations were obtained as a result of a special definition of the connection between coordinate times determining simultaneous positions of two particles in two inertial reference frames. The equation expressing a sufficient form-invariance condition of the equations of motion was obtained. Conservation laws reflecting the symmetry of the action integral were found. In particular it was shown that the center-of-mass integral is a consequence of the Lorentz-invariance condition. The expression for the center-of-mass coordinates was written. The example of a relativistic interaction Lagrangian was considered. The well known nonrelativistic and quasi-relativistic results can be obtained by means of expansion in powers of c^{-2}. (auth)

4811 SPACE CUT-OFF APPROACH TO SCATTERING INVOLVING COULOMB-LIKE POTENTIALS. Zorbas, J. (Univ. of Toronto). J. Phys., A (London); 7: No. 13, 1557-1567(1 Sep 1974).

A prescription is given by which the distorted waves and the on-energy-shell T matrix for particles interacting via Coulomb-like potentials can be determined from the corresponding screened distorted waves and on-energy-shell screened T matrix. (auth)

4812 CONFORMAL INVARIANCE AND HELICITY CONSERVATION. Chan, F.; Jones, H.F. (Physics Department, Imperial College, London SW7, England). Phys. Rev. D 10: No. 4, 1321-1326 (15 Aug 1974).

By reformulating conformal invariance in terms of differential operators acting directly on helicity states, we are able to establish the restrictions placed by this invariance on the helicity amplitudes for the scattering of four particles of arbitrary spin. The result is helicity conservation in the form $\lambda_1+\lambda_2=\lambda_3+\lambda_4$ except for exceptional amplitudes $T_{\lambda_1\lambda_2;-\lambda_1,-\lambda_2}$, which survive (subject, however, to a differential constraint). It is conjectured that traces of these restrictions will survive in hadron physics at fixed angle and high energy if indeed the underlying dynamics is asymptotically free. (auth)

4813 ALTERNATIVE ON−SHELL UNITARY FORMALISMS IN THREE−PARTICLE SCATTERING. Kowalski, K.L. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. D 10: No. 4, 1271-1280 (15 Aug 1974).

The on−shell unitary formalism for three−particle scattering found by Cahill is simplified and its connections with the alternative K−matrix formalism is established. The different results obtained in the approximate but fully unitary three−nucleon calculations which have been carried out to date using the two formalisms are found to be attributable to distinct choices of the approximate input. This last circumstance is obscured in the original versions of the two formalisms. It is concluded that most, if not all, differences between alternative on−shell unitary formalisms are illusory and result from input inequivalence in the various approximation schemes that may seem suited to the various formalisms. (auth)

4814 ANALYTIC CONTINUATION OF THE TWO−REGGEON−CUT DISCONTINUITY FORMULA. White, A.R. (National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 10: No. 4, 1236-1245 (15 Aug 1974).

We give a detailed treatment of the analytic continuation of the two−Reggeon−cut discontinuity formula from above the four−particle threshold in the t channel down to negative t. We confirm the negative sign of the two−Pomeron−cut contribution to the total cross section. We show how the Mandelstam graphs can be used as a check on this result. We trace the negative sign to signature factors and use this to argue that multi−Pomeron cuts should contribute to the total cross section with alternating signs. (auth)

4815 TRANSITION AMPLITUDES IN THE N−BODY FADDEEV−TYPE THEORY. Karlsson, B.R.; Zeiger, E.M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 4, 1291-1298 (15 Aug 1974).

Within the framework of the Faddeev−type N−body scattering formalism, we find the transition operators for all N−body processes that start from two−cluster initial states, and construct the N−body Faddeev−type equations they satisfy. In particular, we show that our previous N−body generalizations of the three−body operator $K_{\beta\alpha}$ correspond to the N−body scattering amplitudes for complete breakup, and that the Alt−Grassberger−Sandhas N−body generalizations of the three−body transition operator $U_{\beta\alpha}$ correspond to N−body elastic and rearrangement amplitudes. As an introduction, we give a simple derivation of the N−body Faddeev−type equations for the wave−function components. (auth)

4816 CONVENTIONAL AND MODIFIED WKB APPROXIMATION WITH A SINGULAR POTENTIAL. Cao-Xuan-Chuan; Ho-van-Hoa. (Univ. of Saigon, Viet-Nam). Nuovo Cim.; 24B: No. 1, 141-151(11 Nov 1974).

An analytical expression in terms of the quantum number l of the conventional WKB phase shift for singular potentials (i.e. $V(r) = A_n r^{-n}$, $n \geq 3$) is derived. It is shown that the asymptotic form of this expression for high values of l as well as for low energies agrees with well known results. The modified WKB approach is discussed to the "zero" and "first" order approximation where the connection between the conventional and the modified approaches is underlined. A general expression of the modified phase shift is obtained. It is also shown that, in the case of low energies, its asymptotic form agrees well with results obtained previously. (auth)

4817 GENERALIZATION OF THE FOCK REPRESENTATION OF THE CANONICAL EXCHANGE RELATIONS. Riml, H. Lett. Nuovo Cim.; 11: No. 9, 454-458(2 Nov 1971). (In German).

The law which states that each normalizable symmetric n-particle wave function fulfilling the Klein-Gordon equation can be written in a given form is proven. With this construction of the wave functions each desired correlation between particles, compatible with the Bose-Einstein statistics, can be represented. The construction of free particles can be expanded to nonfree particles. These considerations are significant in the relativistic theory of the bound state. (JSR)

4818 IS THE TWO-PARTICLE SCATTERING AMPLITUDE ALWAYS A BOUNDARY VALUE OF A REAL ANALYTIC FUNCTION. Nakanishi, N. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 51: No. 3, 912-919(Mar 1974).

It is pointed out that in spite of the Bros–Epstein–Glaser theorem in the axiomatic field theory, there exists a possibility that the on-the-mass-shell scattering amplitude for the two-particle-to-two-particle process is not necessarily a boundary value of the on-the-mass-shell restriction of the analytic function whose boundary value is the off-the-mass-shell scattering amplitude. A Feynman integral is analyzed in this connection, and it is shown how this example is trouble-making to the analytic S-matrix theory. (auth)

4819 SUPER-QUANTIZATION. II. General Functional Integration Formula. Okubo, S. (Univ. of Rochester, NY). Progr. Theor. Phys. (Kyoto); 51: No. 3, 920-944(Mar 1974).

It was shown that with a general definition of time-ordered products, a unitary S matrix for fields with multi-dimensional coordinates can be expressed in a form of Feynman's functional (or path) integral. Though one need not assume existence of equation of motion for free field, the result is found to be equivalent to a formal introduction of generally nonlocal and possibly hermitian free action. A direct proof of the unitarity of the S matrix as well as Bogoliubov causality condition was presented on the basis of the path-integral formula. A possible unitarization of nonlocal interaction theories is suggested by means of the same method. Finally, as an application, a quantum statistical partition function for a boson field was given in the path-integral form. (auth)

4820 TIME-DEPENDENT SCATTERING THEORY FOR HIGHLY SINGULAR POTENTIALS. Pearson, D. B. (Univ., Geneva). Helv. Phys. Acta; 47: No. 3, 249-264(1974).

Asymptotic completeness of the wave operators is proved for scattering of a particle by a wide class of highly singular short-range potentials, which may be either attractive or repulsive. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

Refer also to abstract 4842.

4821 (AD-780167) EXPERIMENTS ON THE FORMATION AND SURFACE STATES OF ADSORBED HELIUM FILMS. Final Technical Report. Brewer, D. F. (Sussex Univ., Brighton (UK)). Jan 1974. Contract DAJA37-73-C-2416. 47p. NTIS $3.25.

The phases of He_3 and He_4 adsorbed on a porous substrate at low temperatures was investigated to yield information on gas surface interactions, formation and structure of films, the effect of size limitation on the properties of three-dimensional material, free surface states on the film, and mean free path effects. The background to the work is described, including the recent discovery of superfluidity in liquid He_3 which is closely allied to superconductivity in metals. Results of nuclear magnetic resonance measurements on monolayer and submonolayer He_3 are described and discussed in terms of the mode of formation of the films. A description is given of the design and construction of a novel type of compressional refrigeration apparatus, and of apparatus to measure the density of adsorbed helium at the lambda transition in He_4 and at the critical points of He_3 and He_4. (auth)

4822 (COO-1569-117) EXPERIMENTAL STUDIES IN SOLID STATE AND LOW TEMPERATURE PHYSICS. Annual Progress Report, 1974. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). Sep 1974. Contract AT(11-1)-1569. 27p. Dep. NTIS $4.50.

Experimental investigations have been carried out in a broad area of low-temperature and solid-state physics which includes superconductivity, magnetism in metals, and liquid and solid helium. The pair-field susceptibility of a superconductor has been determined both above and below T_c and a propagating collective mode has been identified. Anomalies in the heat capacity of superconducting films in the vicinity of T_c have been studied. The sublattice magnetizations of Mn_2Sb have been studied using nuclear resonance techniques. Nuclear orientation thermometry has been studied down to 4 mK and ^{60}Co in Ni has been found to give the most accurate indication of temperature. Nuclear demagnetizations of Pr—Cu and Pr—In alloys have been carried out. Measurements of the differential osmotic pressure of ^{3}He/^{4}He near the tricritical point have shown a peak in the "concentration susceptibility" at the lambda line. Additional studies of mixtures have revealed the existence of wall-film superfluidity. Studies of superfluid flow through regular pores of submicron diameter are also being carried out in pure ^{4}He and in ^{3}He/^{4}He mixtures. The Vinen method is being used to study superfluid circulation around fine wires. The specific heat of bcc solid ^{3}He is being studied at low temperatures. (auth)

4823 LONGITUDINAL AND TRANSVERSE RESONANCE IN THE B PHASE OF SUPERFLUID He^3. Osheroff, D.D. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. Lett. 33: No. 17, 1009-1012 (21 Oct 1974).

I report measurements of the longitudinal resonance in the B phase of superfluid He^3 at melting pressures over a broad temperature interval. I also present the results of a transverse NMR study in the B phase which is designed to test the theory of textures in the B phase and to provide accurate measurements of the B—phase susceptibility. Finally, I report the first measurements of a field—dependent frequency shift in the transverse B—phase NMR associated with the anisotropy energy of the rotation axis of the Balian—Werthamer state. (auth)

4824 OBSERVATION OF PERSISTENT CURRENTS IN A SATURATED SUPERFLUID FILM. Galkiewicz, R.K.; Hallock, R.B. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Phys. Rev. Lett. 33: No. 18, 1073-1076 (28 Oct 1974).

We report the first observation of a persistent flow around a closed path consisting entirely of saturated superfluid helium film in a macroscopic geometry in which the saturated vapor was in unconstrained proximity to the film. (auth)

4825 THICKNESS OF A MOVING HELIUM—II FILM. Graham, G.M.; Vittoratos, E. (Department of Physics, University of Toronto, Toronto, Canada). Phys. Rev. Lett. 33: No. 19, 1136-1139 (4 Nov 1974).

The thickness of a superfluid helium film in steady radial horizontal flow to a central sink has been determined at two radii. The thickness difference is found to be consistent with the prediction of Kontorovich, despite conditions which would favor recondensation from the vapor onto the flowing film. (auth)

4826 ONSET PHENOMENA IN SUPERFLUID HELIUM. Wang, T.G.; Saffren, M.M.; Olli, E.E.; Elleman, D.D. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103). Phys. Rev. Lett. 33: No. 19, 1132-1135 (4 Nov 1974).

Onset phenomena in superfluid helium have been studied by measuring the rotational decay constant of a levitated, superconducting niobium sphere coated with an unsaturated superfluid film. The novel features of onset that were observed are discussed. Previous observations of a two—layer—thick solid phase of helium underlying the film have been confirmed. (auth)

4827 HIGH ELECTRIC FIELD BEHAVIOR OF NEGATIVE IONS IN SUPERFLUID HELIUM. Liu, Y. Atlanta; Georgia Inst. of Tech. (1974). 104p. University Microfilms Order No. 74-21,572.

Thesis (Ph. D.).

Several years ago, it was discovered that the negative helium was able to travel macroscopic distances in a zero electric field after it had passed through a region of high electric field. This phenomenon has been named the "persistence" of the drift velocity of the ion. This persistence current (persistence ion complex) has been interpreted as an electron trapped in a circular, singly quantized vortex ring. The experiments of this thesis project have been designed to test the vortex ring interpretation of persistence current by making range and size measurements and to discover additional properties of the persistence ion complex. The farthest distance a vortex ring will go in a field-free region is defined as the range of the vortex ring. Size and range are directly related, knowledge of one is equivalent to knowledge of the other. A size measurement consists of placing a grid with appropriate sized openings in the path of the ion beam, which is produced by applying dc voltages between a radioactive source (Americium – 241, 19 μCi) and a collector. A vibrating reed electrometer is connected to the collector to measure the currents. The following conclusions have been reached as a result of this research: 1. The persistence ion complex is not an electron trapped in a circular, singly quantized vortex ring. 2. The size of the persistence ion complex is about 35 microns. 3. The persistence ion complex can be created while the ion is in the vortex ring state. 4. The persistence ion complex breaks up at a sufficiently high electric field. (Diss. Abstr. Int., B)

4828 SUPERFLUIDS WITH $l \neq 0$ COOPER PAIRS: PARAMETRIZATION OF THE LANDAU FREE ENERGY. Barton, G.; Moore, M. A. (Univ. of Sussex, Eng.). J. Phys., C (London); 7: No. 17, 2989-3000(7 Sep 1974).

The number of linearly independent terms is ascertained in the most general expression, to fourth power of the order parameter, for the Landau free energy of a superfluid having Cooper pairs with nonzero orbital angular momentum l; this then determines how many input parameters must be supplied by any underlying dynamical theory before the free energy can be minimized near the critical temperature. There are $(l + 1)$ such parameters for l even (singlet pairing), and $(3l + 2)$ for l odd (triplet pairing). Also solved is the restricted but technically harder problem for triplet pairing with the order parameter (a spin—space matrix), constrained to be proportional to a unitary matrix. In this case $(l + 1)$ input parameters are needed. (auth)

4829 GENERATION OF PULSED SECOND SOUND. Trefny, J. U. (Clarendon Lab., Oxford). Phys. Lett., A; 48A: No. 5, 363-364(15 Jul 1974).

It is shown that consideration of source terms in the wave equation for second sound is essential to the interpretation of observed pulse shapes. In particular, the feature of negative temperature excursions, previously studied in the case of helium II, is shown to be a general property of second sound propagation in any system. (auth)

4830 LIGHT SCATTERING FROM THERMAL SECOND SOUND IN LIQUID ^{4}He NEAR THE LAMBDA-TRANSITION AND AT 1.9 ATMOSPHERES. Winterling, G.; Miller, J.; Greytak, T. J. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett., A; 48A: No. 5, 343-344(15 Jul 1974).

The linewidth and frequency shift of light scattered from thermal second sound in liquid ^{4}He have been measured at a pressure of 1.9 atm and at temperatures from 0.3 mK to 4.0 mK below T_λ. The data are compared with previous low frequency measurements. (auth)

4831 EXPLANATION OF ANOMALOUS HELIUM FILM TRANSFER ON PLEXIGLAS. Harris-Lowe, R. F. (Royal Military Coll., Kingston, Ont.); Turkington, R. R.; Daunt, J. G. Phys. Lett., A; 48A: No. 5, 323-324(15 Jul 1974).

The basic phenomena recently reported by Esel'son et al., obtained during helium film transport measurements over perspex were observed. The results are consistent with an explanation based on thermal effects. (auth)

4832 MIXTURE OF BOSE-FLUIDS. Nepomnyashchii, Yu. A. (Perm State Univ., USSR). Teor. Mat. Fiz.; 20: No. 3, 399-412 (Sep 1974). (In Russian).

Microscopic theory of mixture of Bose-fluids with a condensate is developed. The spectrum and structure of one-particle excitations is investigated. The possibility of superfluidity disappearing at mixing of superfluid components is established. The question about superfluid movement of a certain Bose-fluid through another one is investigated. Conditions of spontaneous exfoliation of mixture are considered. (auth)

4833 FREQUENCY DEPENDENCE OF THE TRANSMISSION OF HIGH-FREQUENCY PHONONS FROM A SOLID INTO LIQUID HELIUM. Swanenburg, T. J. B.; Wolter, J. (Philips Research Labs., Eindhoven, Netherlands). Phys. Rev. Lett.; 33: No. 15, 882-885(7 Oct 1974).

Heat pulse experiments at 1.8 K show the transmission coefficient of high-frequency phonons from silicon into superfluid helium to exhibit a maximum at a heater temperature of about 5 K. (auth)

4834 PARAMETRIC EXCITATION OF SECOND SOUND BY FIRST SOUND IN LIQUID HELIUM II. Pushkina, N. I.; Khokhlov, R. V. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 19: No. 11, 348-349(5 Jun 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 11, 672-676(5 Jun 1974).

Nonlinear combination (Raman) interaction of first sound with second sound in liquid helium II–parametric excitation of second sound by an exciting first-sound wave, is considered. An expression is obtained for the threshold intensity of the first sound, at which excitation the second-sound waves set in. The possibility of experimentally observing the phenomenon is discussed. (auth)

4835 EFFECTIVE INTERACTION IN LIQUID He. Iachello, F. (Univ., Groningen, Netherlands); Rasetti, M. Lett. Nuovo Cim.; 11: No. 9, 477-479(2 Nov 1971).

The analysis in terms of the effective interaction seems to indicate that the behavior of liquid He II is similar to that of a dense hard-sphere Bose gas and that this may provide a good starting point in constructing a microscopic theory of liquid He. (MHR)

4836 DAMPING OF TORSIONAL OSCILLATIONS OF A QUARTZ CRYSTAL CYLINDER IN LIQUID HELIUM AT LOW TEMPERATURES. I. Viscosity of Pure ^{3}He. Bertinat, M. P.; Betts, D. S.; Brewer, D. F.; Butterworth, G. J. (Univ. of Sussex, Brighton, Eng.). J. Low Temp. Phys.; 16: No. 5/6, 479-494 (Sep 1974).

Measurements were made of the viscosity of pure liquid ^{3}He at the saturated vapor pressure over the temperature range 20 mK to 1 K, by observation of the decay of torsional oscillations of a crystalline quartz cylinder. The results generally confirm previous measurements by other methods, but are more accurate and extend over a wider temperature range. Careful data analysis has been carried out to determine the best fit, which is given by the equation $(\eta T^2)^{-1} = A_0 + A_1 T^n$, with $A_0 = 0.5450$, $A_1 = -1.594$, and $n = 1$ (with η in micropoise) and which indicates that higher-order terms in T ($n > 1$) are inappropriate. The coefficient A_1 is four times larger than that given by theory which calculates it with use of only the Z_0 Landau parameter, indicating that other interaction parameters should be included. (auth)

4837 PROPAGATION OF ZERO SOUND IN THE BALIAN–WERTHAMER STATE. Maki, K. (Univ. of Southern California, Los Angeles). J. Low Temp. Phys.; 16: No. 5/6, 465-477(Sep 1974).

The propagation of zero sound in the superfluid state of the type suggested by Balian and Werthamer is studied theoretically. In the collisionless limit the attenuation of zero sound takes place only for $\omega \geq 2\Delta(T)$ and at $\omega = 2(3/5)^{1/2}\Delta(T)$, where ω is the frequency of the sound wave and $\Delta(T)$ is the temperature-dependent order parameter. (auth)

4838 WAVEGUIDE PARTIALLY PACKED WITH SUPERLEAK AS A PROBE OF SUPERFLUID PROPERTIES. Rudnick, J.; Rudnick, I.; Rosenbaum, R. (Technion–Israel Inst. of Tech., Haifa). J. Low Temp. Phys.; 16: No. 5/6, 417-429(Sep 1974).

A waveguide partially packed with superleak and filled with superfluid ^{4}He is proposed as a useful configuration for studying acoustic modes. A calculation is performed indicating that the low-frequency propagating modes in such a system are of two types: a combined first/fourth sound mode and a modified second sound type mode. Experimentally, the waveguide is closed back on itself to form a toroidal resonator. Resonant frequencies were measured, and the experimental results compared favorably with the calculations. However, there remain unresolved discrepancies. This resonator may prove useful in measuring the possible superfluid properties of the new state of ^{3}He. (auth)

4839 IONS IN THE HELIUM FILM. Gribbon, P. W. F.; Kennedy, S. G. (Univ. of St. Andrews, Fife, Scotland). J. Low Temp. Phys.; 16: No. 5/6, 591-606(Sep 1974).

The existence of a small negative ion current flow in a saturated helium film has been inferred from the current collected at electrodes situated in the vapor above a surface of liquid helium in diode and triode cells. Currents to a disk collector in the vapor and a ring collector in the helium film on the walls were measured as a function of temperature between 0.9 and 4.2 K and of applied field up to 200 V cm^{-1}. A current of $\sim 10^{-13}$ A attributed to an ion flow in the film was detected in a temperature range 1.2 to 1.6 K and at low fields < 70 V cm^{-1} under conditions where the current to the collector in the vapor was much smaller than the current to the collector in the film. A positive current which appeared to reach the collector in the vapor was attributed to a negative current of photoelectrons emitted from the collector into the vapor. (auth)

4840 INTENSITY OF CRITICAL OPALESCENCE OF HELIUM-4. Tominaga, A. (Tokyo Univ. of Education). J. Low Temp. Phys.; 16: No. 5/6, 571-589(Sep 1974).

Measurements of the critical opalescence of helium-4 are presented. The results are analyzed by the Einstein and Ornstein–Zernike theory and the power laws. $\gamma = \gamma' = 1.17 \pm 0.02$, $\nu = \nu' = 0.62 \pm 0.1$, $\Gamma/\Gamma' = 4.5 \pm 0.3$, $P_c = 1706.008$ mm Hg, and $T_c = 5{,}189.863$ mK (T_{58}) were obtained. The critical behavior of helium-4 is almost the same as that of classical fluids and the influence of the quantum nature of helium-4 is not as evident as has been claimed. (auth)

4841 VORTEX NUCLEATION IN DEFORMED ROTATING CYLINDERS. Fetter, A. L. (Stanford Univ., CA). J. Low Temp. Phys.; 16: No. 5/6, 533-555(Sep 1974).

Superfluid states in a rotating elliptic cylinder are studied with semiclassical hydrodynamics. Two distinct approaches are used to obtain the critical angular velocity for the appearance of a vortex: (1) Equilibrium thermodynamics predicts that Ω_{c1} increases monotonically with deformation at fixed cross-sectional area; (2) Predictions based on a critical slip speed v_c at the walls depend on the detailed form of v_c; the resulting Ω_c need not vary monotonically with deformation. The analogous situation in a rectangular cylinder is also discussed. (auth)

Superconductivity

Refer also to abstracts 3902, 3997, and 4822.

4842 (AD-779451) THEORETICAL PROBLEMS IN SOLID STATE AND LOW TEMPERATURE PHYSICS. Final Report, 1 September 1968–31 August 1973. Bardeen, J.; Pines, D. (Illinois Univ., Urbana (USA). Dept. of Physics). 14 Apr 1974. Contract DAHC04-69-C-0007. 11p. (AROD-7941.31-P). NTIS $3.00.

The major fields in which work was done are (1) superconductivity, (2) properties of liquid helium and ^{3}He–^{4}He mixtures, (3) electronic structure of solids, (4) plasmas and turbulence in liquids, (5) phenomena in the vicinity of magnetic phase transitions, and (6) surface and interface effects. A common theme is application and development of techniques or many-body theory, that is systems of many interacting particles. (GRA)

4843 (JINR-P4-8150) EXACTLY SOLUBLE MODEL FOR SUPERCONDUCTORS WITH ELECTRON-HOLE COUPLING. Brankov, I. G.; Tonchev, N. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

An asymptotic solution is obtained for a one-band model of a metal with BCS-type and electron-hole interactions taken into account simultaneously. In the considered case of half-field band, a region of co-existence of excitonic and superconducting phases is found. Under the assumed conditions, the existence of structural phase transition does not lead to a higher superconducting critical temperature. (auth)

4844 QUANTIZATION OF MAGNETIC FLUX AT TEMPERATURES ABOVE THE SUPERCONDUCTING TRANSITION TEMPERATURE. Shablo, A. A.; Narbut, T. P.; Tyurin, S. A.; Smitrenko, I. M. (Physical-Technical Inst. of Low Temperatures, Kharkov). JETP Lett. (USSR) (Engl. Transl.); 19: No. 7, 246-247(5 Apr 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 7, 457-461(5 Apr 1974).

The quantization of the magnetic flux under conditions of fluctuation pairing was investigated experimentally. The conductivity oscillations of hollow thin-wall aluminum microcylinders were observed in a longitudinal magnetic field up to 8°K. Qualitative agreement with theory is obtained under the assumption that the coherence length of the investigated samples is anomalously large. (auth)

4845 THEORY OF GOR'KOV MODEL FOR A15 COMPOUNDS. Noolandi, J. (Bell Telephone Laboratories, Holmdel, New Jersey 07733). Phys. Rev. Lett. 33: No. 19, 1151-1154 (4 Nov 1974).

The Gor'kov model for the A15 compounds predicts the appearance of a gap in the d–electron spectrum between the superconducting transition temperature, T_c, and the martensitic–phase–transition temperature, T_m. A mean–field calculation of the gap parameter is carried out for Nb_3Sn and V_3Si, using the measurements of the soft mode in the cubic phase. It is suggested that the theory be verified by optical or tunneling measurements. (auth)

4846 TEMPERATURE DEPENDENCE OF THE LATTICE PARAMETER d_0 IN TYPE-II/1 SUPERCONDUCTORS. De Cesare, L.; Mancini, F. (Univ., Salerno, Italy). Solid State Commun.; 15: No. 5, 815-818(1 Sep 1974).

The distance r_m, where the magnetic field of an isolated flux line has a minimum (and r is the distance from the center of the flux line), is computed as function of the temperature. Good agreement with the experimental data for the lattice parameter is found in the region $0 \le T/T_c \le 0.5$. (auth)

4847 DYNAMICS OF ORDER PARAMETER FLUCTUATIONS IN GAPLESS SUPERCONDUCTORS BELOW T_c. Brieskorn, G.; Dinter, M.; Schmidt, H. (Univ., Munich). Solid State Commun.; 15: No. 4, 757-760(15 Aug 1974).

The dynamical pair field susceptibility of gapless superconductors has been calculated using the theory of Gorkov and Eliashberg (J. Low Temp. Phys.; 2(1970)) and improvements thereof. The result differs drastically from the usual Ginzburg–Landau theory and agrees qualitatively with recent experiments on the I–V characteristic of tunnel junctions with Al films. (auth)

4848 NEW CORRELATION: SUPERCONDUCTING CRITICAL TEMPERATURE VS. NUMBER OF NATURALLY OCCURRING ISOTOPES AMONG SUPERCONDUCTING ELEMENTS. Wang, F. E.; Mitchell, M. A. (Naval Ordnance Lab., Silver Spring, MD). Solid State Commun.; 15: No. 5, 867-869(1 Sep 1974).

An experimental correlation between the superconducting critical temperature, T_c, and N, the number of naturally occurring isotopes for all the known superconducting elements, has been obtained. Based on current theories, the reason for such a correlation is not immediately obvious. Apparently, some reexamination of the theories is needed. (auth)

4849 FLUX PINNING MECHANISMS IN TYPE II SUPERCONDUCTORS. Dew-Hughes, D. (Univ. of Lancester, Eng.). Phil. Mag.; 30: No. 2, 293-305(Aug 1974).

Expressions for flux-pinning in type II superconductors are derived from considerations of the nature of the interaction between individual fluxlines and pinning-centres, and of the geometry of the pinning-centres. It is demonstrated that the experimentally observed scaling laws are obtained without the necessity of introducing the concept of flux-lattice elasticity. Predicted pinning functions are found to provide adequate explanation of measured Lorentz force curves in a wide range of high-κ, strong-pinning materials. (auth)

4850 DEPENDENCE OF THE NOISE VOLTAGE ASSOCIATED WITH FLUX MOTION IN SUPERCONDUCTORS ON THE ARRANGEMENT OF POTENTIAL LEADS. Jarvis, P.; Park, J. G. (Imperial Coll. of Science and Tech., London). J. Phys., F (London); 4: No. 8, 1238-1245(Aug 1974).

It was originally suggested by one of the authors (JGP) that the noise voltage associated with magnetic flux in superconductors, when the regions enclosing the flux are set in motion by a transport current, should have a spectrum which depends on the manner in which the leads connecting the voltmeter to the sample are arranged. In this paper the results are reported of some experiments which clearly demonstrate the existence of the effect in both type 1 and type 2 superconductors. (auth)

4851 VORTEX MOTION IN SUPERCONDUCTORS. I. De Lange, O. L. J. Phys., F (London); 4: No. 8, 1222-1237(Aug 1974).

The time-dependent Ginzburg–Landau (TDGL) equations, derived by Eliashberg for a superconductor with a low concentration of magnetic impurity ($\tau_s T \gg 1$) near T_c, have been used to calculate the entropy and energy currents and the flux flow conductivity associated with a slowly moving isolated vortex. The effect of the anomalous term in the TDGLE is important. The transported entropy (S_d) and the conductivity (σ_f) depend on κ, τ_s and τ_1 (transport collision time). S_d is decreased by the addition of relatively small amounts of magnetic impurity. The agreement between measurement on dirty nonmagnetic alloys and theory (with $\tau_s T = \infty$) is good. σ_f is calculated for $\tau_1/\tau_s \ll 1$. In the dirty limit $\sigma_f/\sigma = 2.67\ C_\alpha\ \tau_s T H_{c2}/\langle B\rangle$; C_α is of order unity for all κ. When $\tau_1 T \gg \tau_s/\tau_1$, $\sigma_f/\sigma \simeq C_\beta H_{c2}/\langle B\rangle$; $C_\beta \simeq (4\kappa^2)^{-1}$ for large κ, $\simeq 0.1$ for $\kappa \simeq 1/\sqrt{2}$. (auth)

4852 IMPORTANCE OF ENERGY–DIRECTION-COSINE RELATION OF BOUND STATES IN SUPERCONDUCTING WELL. Bar-Sagi, J. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart). Solid State Commun.; 15: No. 4, 729-731(15 Aug 1974).

Experimental results on the tunneling current into normal layers backed by superconducting layers and the thermal conductivity along a superconducting layer coated by a thin magnetic layer have both been thought to contradict the theoretical results obtained from solutions of the Bogoliubov equations. It is shown that the theory explains the experimental results when energy–direction-cosine relations for states bound near the normal–superconductor interface are properly accounted for. (auth)

4853 INCOMPATIBILITY OF BCS PAIRING AND THE PEIERLS DISTORTION IN LINEAR CHAIN SYSTEMS. Levin, K.; Mills, D. L.; Cunningham, S. L. (Univ. of California, Irvine). Solid State Commun.; 15: No. 4, 705-709(15 Aug 1974).

The coupled gap equations have been solved for a one-dimensional electron gas which can undergo both a Peierls insulating and a BCS superconducting transition. It is found that, except for a very special case, (i) only one of the order parameters can be nonvanishing and (ii) there is only one critical temperature. It is concluded that, independent of the pairing interaction strength, if the Peierls transition occurs, there can be no BCS superconductivity, and conversely. (auth)

4854 EXTERNAL FIELD EFFECT ON THE CURRENT DISTRIBUTION IN SUPERCONDUCTING COMPOSITES: EVALUATION OF THE DEGRADATION IN ADIABATIC CONDITIONS. Duchateau, J. L.; Turck, B. (CEN de Saclay, Gif-sur-Yvette, France). Cryogenics; 14: No. 10, 545-550(Oct 1974).

Since cooling conditions in coils are not very good, it is important to develop a nearly intrinsically stable superconducting composite. The external field effect greatly improves current distribution inside the composite and therefore improves the adiabatic stability of the composite. For a typical composite with an equal proportion of copper and superconductor, subjected only to its self-field, the maximum permissible number of filaments for an expected 10% current degradation is: $N_{max} = 800$ for a 10μ diameter filament, $N_{max} = 2700$ for a 5μ diameter filament. For the same composite subjected to an external field of up to 5 T, $N_{max} = 2000$ for a 10μ diameter filament, $N_{max} = 7000$ for a 5μ diameter filament. This suggests the leading part of a large coupling factor K equal to B_{ext}/I supplies a good current redistribution in the composite. Consequently, degradation is expected to be more important in a massive elementary conductor than in a multistrand cable carrying the same overall current. (auth)

4855 T_c OF SUPERCONDUCTING ALLOYS WITH NARROW ENERGY BANDS. Appel, J. (Univ., Hamburg). Solid State Commun.; 15: No. 6, 1043-1045(15 Sep 1974).

The vertex equation for a Cooper pair is solved for T_c of an A–B alloy, assuming a single-site interaction between electrons. The result depends on the partial densities of state $N_A(0)$, $N_B(0)$, the intraatomic Coulomb repulsions, and the attractive interaction which contains the normal-mode density g(z) and the matrix elements of the ion-potential gradients between two electrons at one and the same site. (auth)

4856 RENORMALIZATION OF THE EXPRESSION FOR THE SUPERCONDUCTING TUNNELLING CURRENTS. Hasselberg, L. E. (Danmarks Tekniske Hoejskole, Lyngby). J. Phys., F (London); 4: No. 9, 1433-1446(Sep 1974).

The singularities of the expressions for the superconducting tunnelling currents are shown to be caused by the fact that they are derived via a perturbation calculation of finite order. A general formula for the current density valid for large tunnelling matrix elements and exterior electromagnetic fields is derived. Then it becomes possible to obtain a broadened quasiparticle current step and a finite Riedel peak. In addition, a renormalized second-order quasiparticle current is shown to be finite for every DC voltage. The method employed is to sum the corresponding types of diagrams to infinite order. (auth)

4857 KNIGHT EFFECT IN SUPERCONDUCTORS. Niculescu, V.; Crisan, M. (Univ., Cluj). Stud. Cercet. Fiz.; 25: No. 4, 471-485(1973). (In Rumanian).

The following topics are discussed: introduction, theory of Knight shift, Knight shift in superconductors, Knight shift in Hg and Sn, the microscopic description of the superconductivity, the magnetic susceptibility, the triplet states contribution, the spin-orbit contribution, Knight shift in V and Nb superconductors, Knight shift in Al superconductor, and Knight shift in superconducting alloys. (auth)

4858 EXTENSION OF THE DEJONG–BLAISSE MODEL FOR HYSTERESIS AND FLUX TRAPPING IN SUPERCONDUCTORS TO INCLUDE A MAGNETIZABLE NORMAL STATE. Smith, C. W. (Univ. of Maine, Orono). Phys. Lett., A; 48A: No. 5, 349-350(15 Jul 1974).

A model for the magnetic behavior of superconductors showing an incomplete Meissner effect is extended to include a magnetizable normal state. Results indicate an enhancement of flux trapping. Storage of magnetic fields by superconducting bar magnets is briefly discussed. (auth)

4859 SOME PROBLEMS OF STUDYING MODEL HAMILTONIANS OF STATISTICAL PHYSICS. I. General Theorems for Free Energy. Kurbatov, A. M.; Lapushkin, S. S. (Inst. of Mathematics, Moscow). Teor. Mat. Fiz.; 21: No. 1, 103-110 (Oct 1974). (In Russian).

The methods developed by N. N. Bogoliubov (Jr) for studying model systems of statistical physics with four-fermion interaction are applied to investigation of the system with the Hamiltonian of general form. Dynamical operators are not concretized, but instead the fulfillment of certain very general conditions is required. Special cases of this system are the model BCS in the theory of superconductivity and the models of ferromagnetics of the Heisenberg and Ising type. The theorems for free energy of this model system are offered, which generalize well-known theorems. (auth)

4860 CRITICAL TEMPERATURE OF ANISOTROPIC AND INHOMOGENEOUS SUPERCONDUCTORS. Gvozdikov, V. M.; Fal'ko, I. I. (Kharkov State Univ.). Teor. Mat. Fiz.; 21: No. 1, 111-117(Oct 1974). (In Russian).

It is shown that the equation for determining the critical temperature of superconductive transition coincides formally with corresponding equation of the BCS theory, if spatial inhomogeneity and anisotropy of the superconductor is taken into account and certain rather general conditions on the form of inter-electron interaction are imposed. (auth)

4861 KONDO EFFECT IN SUPERCONDUCTING DILUTE MoCo, MoFe, AND MoMn ALLOYS. Takayanagi, S.; Takano, M.; Kimura, Y.; Sugawara, T. (Tokyo Univ.). J. Low Temp. Phys.; 16: No. 5/6, 519-531(Sep 1974).

The superconducting critical fields H_c and the critical temperatures T_c have been measured down to 0.05 K in a series of dilute alloys of MoCo, MoFe, and MoMn. These systems have T_K/T_{c0} of 50, 0.3, and 15, respectively, where T_K is the Kondo temperature of the alloy and T_{c0} is the critical temperature of pure Mo. The critical fields at $T = 0$ and the specific heat jump at T_c have been estimated from the observed H_c and compared with the theories of the magnetic impurity effect in superconductors. The behavior of these quantities and the density of states are found to depend strongly upon T_K/T_{c0} in agreement with theory. From the results it is inferred that in the limit of large T_K the superconducting properties of a Kondo alloy would tend to those of the Abrikosov–Gor'kov theory. (auth)

4862 ELIMINATION OF SUPERCOOLING IN SUPERCONDUCTORS BY THE PROXIMITY EFFECT: NEW BOUNDS ON T_c FOR Mg, Ag, AND Au. Buhrman, R. A.; Halperin, W. P. (Cornell Univ., Ithaca, NY). J. Low Temp. Phys.; 16: No. 5/6, 409-415(Sep 1974).

The use of the superconducting proximity effect to eliminate supercooling in a type I superconductor is reported. This effect has been demonstrated to be completely successful when applied to a tungsten specimen. It has also been employed to firmly establish new low upper bounds on the possible superconducting transition temperature of Mg, Ag, and Au. (auth)

4863 FLUCTUATION PHENOMENA BELOW THE SUPERCONDUCTING TRANSITION. Maki, K.; Sato, H. (Tohoku Univ., Sendai). J. Low Temp. Phys.; 16: No. 5/6, 557-570(Sep 1974).

The fluctuation propagator for the superconducting order parameter below T_c is derived for a gapless superconductor. The fluctuation of the order parameter consists of two distinct modes: the fluctuations of the phase and the modulus of the order parameter. The former fluctuation obeys a phononlike dispersion, while the latter fluctuation is described by a damping diffusion type equation. The present theory gives an account of the fluctuation-induced Josephson effect below T_c observed recently by Carlson and Goldman. (auth)

4864 UPPER CRITICAL FIELD OF LAYERED SUPERCONDUCTORS. Klemm, R. A.; Beasley, M. R.; Luther, A. (Harvard Univ., Cambridge, MA). J. Low Temp. Phys.; 16: No. 5/6, 607-613(Sep 1974).

The results of a theoretical study of the upper critical fields of layered superconducting compounds are presented. It is found that for sufficiently decoupled layers the parallel critical fields $H_{c2,||}$ can be quite large compared to those expected with ordinary type II superconductors and essentially determined by the destruction of the superconductivity in the individual superconducting layers. It is found that $H_{c2,||}$ can be calculated from standard pair breaking theory in terms of a pair breaking parameter appropriate for layered compounds. The pair breaking parameter includes both orbital effects and the effects of Pauli paramagnetism and spin–orbit scattering. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 5036, 5053, 5298, 5302, and 5305.

4865 (AEEW-R-950) PREPARATION OF WIMS LIGHT AND HEAVY WATER THERMAL SCATTERING DATA. Butland, A. T. D.; Oliver, S. M. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Jun 1974. 37p. Dep. NTIS (US Sales Only) $4.75.

This report describes the preparation at seven temperatures in the range 293°K to 620°K of multigroup thermal-neutron scattering data for hydrogen in light water based on Nelkin's model and for deuterium in heavy water based on Honeck's model. The data are examined in the light of neutron diffusion and total cross-section measurements. (8 figures, 8 tables) (auth)

4866 (RT/FI-(74)31) POSITIVITY, DOMINANCE, AND UNIFORM CONTINUITY OF SOLUTION TO THE NEUTRON INTEGRAL BOLTZMANN EQUATION IN THREE-DIMENSIONAL CRITICAL SYSTEMS. Premuda, F.; Spiga, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jun 1974. 45p. Dep. NTIS (US Sales Only) $5.25.

The criticality of a three-dimensional finite system, made by isotropically scattering and multiplying inhomogeneous materials, is discussed in detail. The linear integral Boltzmann equation for monoenergetic neutrons is investigated in the framework of the theory of compact linear integral transformations in a Lebesgue space L_p. The main physical characteristics and implications of criticality are seen in the light of the mathematical concept of the dominance of the fundamental positive flux distribution. This suggests an iterative procedure and a direct method in order to build up a practical series solution for the critical neutron total flux, whose convergence still lies on its dominance. (auth)

4867 (TID-26286, pp 56-65) CRITICALITY COMPUTATIONS: AN OVERVIEW. O'Dell, R. D. (Univ. of New Mexico, Albuquerque). 1974.

In nuclear criticality safety.

A review of those aspects of neutron physics important to criticality computations is presented. The acquisition of neutron cross-section data for use in computations is discussed. Both multigroup concepts and resonance treatments are examined. The Monte Carlo method, the diffusion theory method, and discrete ordinates methods for criticality calculations are reviewed. (JWR)

4868 CALCULATION OF GREULING-GOERTZEL ELASTIC SLOWING-DOWN PARAMETERS FOR ANISOTROPIC HIGH ENERGY SCATTERING. Gurin, V. N. Sov. At. Energy (Engl. Transl.); 35: No. 6, 1124-1125(Dec 1973).

Translated from At. Energ. (USSR); 35: No. 6, 425(Dec 1973). This is a summary of paper No. 708/7360 with full copy held at TIC.

Equations are proposed for calculating the elastic slowing-down parameters associated with an arbitrary elastic scattering law. The results of calculating $\xi(E)$ and $\lambda_0(E)$ for ^{12}C, ^{16}O, and ^{23}Na in the energy range 1 keV to 10 MeV are given in the full paper (but not the summary). (RWR)

4869 SPECIAL FEATURES OF THE RESONANCE ABSORPTION OF NEUTRONS FOR INTERMEDIATE LEVELS. Platonov, A. P.; Luk'yanov, A. A. Sov. At. Energy (Engl. Transl.); 35: No. 4, 924-925(Oct 1973).

Translated from At. Energ. (USSR); 35: No. 4, 264(Oct 1973). This is summary of paper No. 694/7120 with full copy held at TIC.

A numerical procedure was used for solving the slowing-down equation for neutrons in an infinite homogeneous medium to determine the spectrum of the neutron flux in the neighborhood of two intermediate ^{238}U resonances at 189.6 and 208.6 eV for the systems U-H, U-O, U-Fe, and U-Pb. The spectra were used to calculate the effective ^{238}U resonance integrals for various values of the scattering cross section of a nonresonance moderator and for various temperatures of the medium. The values of the resonance integrals for the ^{238}U levels cited calculated by using the familiar approximations differed from the results of numerical calculations for concentrated media by up to 25 to 30%. For media with the same concentrations and temperatures, the resonance integral was found to depend strongly on the A of the nonresonance moderator. A graph of the neutron collision density is given. (1 figure). (RWR)

4870 ANALYSIS OF A PULSED NEUTRON EXPERIMENT BY THE MOMENTS METHOD. Pankratenko, D. A.; Topil'skii. L. N. Sov. At. Energy (Engl. Transl.); 34: No. 6, 581-582(Jun 1973).

Translated from At. Energ.; 34: No. 6, 475-476(May 1973). This is a summary of paper No. 670/6987 with full copy held at TIC.

The moments method is used to obtain a system of equations relating the background Φ and the logarithmic decrement α to the measured number of counts N_i in the i-th analyzer channel ($i = 1, \ldots, n$), corrected for the dead time. It is shown that the moments method equation for the logarithmic decrement, obtained for the decrease in neutron density in the absence of background, agrees with the equation obtained by the maximum probability method with a Poisson distribution. In the iteration procedure used to solve the equations, the logarithmic decrement is calculated by using the number of counts, corrected for background, calculated by the moments method. The iterative process is started with the zeroth approximation to the logarithmic decrement $\alpha^{(0)}$, obtained by any simple method. (auth)

4871 OPTICAL ACTIVITY FOR NEUTRONS. Kabir, P.K. (Physics Department, University of Virginia, Charlottesville, Virginia 22901); Karl, G.; Obryk, E. Phys. Rev. D 10: No. 5, 1471-1474 (1 Sept 1974).

When a neutron passes through an optically active medium, the transverse component of its polarization should process around the direction of propagation while the longitudinal component should increase (or decrease) monotonically. For a representative medium, in a typical case, the rotatory power for neutron polarization is expected to be of order 10^{-5} cm^{-1}. The rate of acquisition of longitudinal polarization is also expected to be of similar magnitude, and the γ rays associated with thermal neutron capture should have circular polarization of order 10^{-7}. (auth)

4872 BOUNDARY AND INTERFACE CONDITIONS FOR APPROXIMATE SOLUTIONS OF THE NEUTRON TRANSPORT EQUATION. Martin, C. L. Ann Arbor, MI; Univ. of Michigan (1974). 153p. University Microfilms Order No. 74-25,263. Thesis (Ph. D.).

Approximate solutions to the time-independent, one-speed neutron transport equation are obtained by the modal expansion method. The modes are chosen to be known angular functions with expansion coefficients which are unknown functions of position. Under these circumstances the modal method leads to a coupled set of differential equations: the diffusion equations in the case of arbitrary geometry and the P_N equations in the case of slab symmetry. Boundary and interface conditions for these equations are derived at the same time as the equations themselves by the use of a variational technique. Each condition is treated as a constraint upon the space of functions which are admissible in the variational principle. The constraint is then removed, i.e., the space of admissible functions is enlarged, by the use of a Lagrange multiplier. In this work the Lagrange multiplier is allowed to have a modal expansion all its own, distinct from the expansion of the adjoint flux. Variationally derived interface conditions are obtained for the first time for the $P_M - P_N$ expansion problem. Finally, the Lagrange multiplier method is applied to the computation of the thermal utilization for a unit cell. The result is shown to be superior in a numerical test to ordinary blackness theory. (RWR)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 4490, 4679, 4781, 4865, 4891, 4895, 4900, 4906, and 4938-4940.

4873 (CERN-74-20) SELECTED PHYSICS DATA ON NEON-HYDROGEN MIXTURES. Leutz, H.; Schmeissner, F.; Wenninger, H. (comps.). (European Organization for Nuclear Research, Geneva (Switzerland)). 10 Oct 1974. 175p. Dep. NTIS (US Sales Only) $12.00.

Thermodynamic and nuclear physics properties of neon-hydrogen mixtures are compiled in two-dimensional tables. The table rows are organized in terms of neon molar fractions starting with pure hydrogen and ending with pure neon. With a few exceptions, the table columns refer to temperatures ranging from 25 to 31 K. Instructions are given on how to prepare bubble chamber fillings of wanted neon-hydrogen composition, by starting either from the pure constituents or from phase-separated liquid mixtures. (auth)

4874 (COO-1764-213) ODD-EVEN FEATURES IN ^3He + ^3H SCATTERING. Brown, R. E.; Chwieroth, F. S.; Tang, Y. C.; Thompson, D. R. (Minnesota Univ., Minneapolis (USA). School of Physics). 1974. 15p. Dep. NTIS $4.00.

The single-channel resonating-group method is used to study effects of the Pauli principle on ^{3}He + ^{3}H scattering. Comparison is made with previous similar calculations for d + ^{3}He scattering, and it is found that the Pauli principle affects the s = 0 state of the ^{3}He + ^{3}H system rather similarly to the way it affects the s = 1 state, whereas the Pauli principle affects the s = $^3/_2$ state of the d + ^{3}He system quite differently from the way it affects the s = $^1/_2$ state. Mention is made of the possibility of observing similar effects of the Pauli principle in other nuclear systems. (auth)

4875 (COO-1764-215) ABSORPTION EFFECTS IN d + α SCATTERING. Thompson, D. R.; Tang, Y. C. (Minnesota Univ., Minneapolis (USA). School of Physics). 1973. 12p. Dep. NTIS $4.00.

Absorption effects in d + α scattering are taken into account by a simple modification in the resonating-group formulation. It is shown that this modification results in the elimination of spurious resonances and leads to a satisfactory agreement with measured values for differential scattering and total reaction cross sections. (auth)

4876 (ITF-74-74E) SPIN STATES AND THE EQUATIONS OF MOTION FOR A FEW NUCLEONS. Simenog, I. V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

The Schroedinger equations for the spatial parts of the wave functions of a four-nucleon system in all spin and isospin states are given. Expressions for the pair potentials belonging to the certain Young's schemes in the case of an arbitrary number of particles are obtained. These expressions are applied to a five-nucleon system in state S = $^1/_2$, T = $^1/_2$. (auth)

4877 (JINR-D1,2-7781, pp 150-163) OBSERVATION OF ANTITRITIUM NUCLEI. Poze, D. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 3rd international symposium on high energy and elementary particle physics; Sinaia, Romania (2 Oct 1973).

4878 ELASTIC SCATTERING OF π^+ AND π^- MESONS ON ^{3}He AT 154 MeV. Falomkin, I. V. (Joint Inst. for Nuclear Research, Dubna, USSR); Kulyukin, M. M.; Lyashenko, V. I.; Pontecorvo, G. B.; Shcherbakov, Yu. A.; Albu, M.; Angelescu, T.; Mihul, A.; Nichitiu, F.; Garfagnini, R.; Piragino, G. Nuovo Cim.; 24A: No. 1, 93-98(1 Nov 1974).

The differential cross sections for the elastic scattering of π^+ and π^- mesons on ^{3}He were measured at 154 MeV with a high pressure streamer chamber for angles between 30 and 160° (c.m.s.). The total elastic cross sections are also presented. (auth)

4879 NEGATIVE MUON CAPTURE IN DEUTERIUM. Raghavan, S. S. (Coll. of Engineering, Guindy, India). J. Phys., A (London); 7: No. 12, 1454-1456(11 Aug 1974).

The total negative muon capture rate in deuterium is calculated using the closure approximation, and the results are compared with those of Pascual et al. (Nuovo Cim. A: 12; 241-8 (1972)), who use the impulse approximation for computing the capture rate. (auth)

4880 NUCLEON-DEUTERON WAVE FUNCTIONS. Tartakovskii, V. K.; Kozlovskii, I. V.; Fursa, A. D. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 7, 1154-1160(Jul 1974). (In Russian).

The wave functions are calculated for three nucleons in the continuous spectrum which represent a system of interacting nucleon and deuteron, when the distance between one of the nucleons and two others is large. The calculations were performed for the two-particle nuclear potential in the square-well form for different relative momenta of the nucleon and deuteron. (auth)

4881 RESCATTERING CORRECTIONS TO THE COHERENT PHOTOPRODUCTION OF π^0 ON ^{4}He, ^{12}C, AND ^{16}O AT LOW ENERGIES. Osland, P.; Rej, A. K. Ark. Fys. Seminar Trondheim; No. 9, 1-48(1974).

Coherent photoproduction of π^0 on ^{4}He, ^{12}C and ^{16}O is studied in the energy region E_γ = 200 to 400 MeV. Corrections due to the second-order scattering are formulated in a model which incorporates the Fresnel correction to the Glauber theory and takes into account the spin and the charge-exchange effects. For ^{4}He and ^{16}O numerical calculations were made. In this energy region the results including the second-order corrections for ^{4}He do not differ very much from the impulse-approximation results while for ^{16}O they are drastically different. However, it is noted that the inclusion of second-order corrections in this energy region is not enough to make possible a final conclusion about the effect of the rescattering, even for ^{4}He at the top of the resonance because the contribution from the second-order term is not small enough to allow for the neglect of higher order correction terms. Of course, the impulse approximation is good around or below 200 MeV for all the nuclei under consideration. Further it is noted that the exchange terms are very important. For ^{4}He the double spin-flip term gives a large contribution, while for ^{16}O it is rather small. (auth)

4882 MEASUREMENT OF ^{3}He SPIN ANALYZING POWER OF 24 MeV PROTONS AND 15.5 MeV ^{4}He. Ware, R. H. Boulder, CO; Univ. of Colorado (1974). 88p. University Microfilms Order No. 74-22,407.

Thesis (Ph. D.).

The spin analyzing power of 26.8-MeV protons on polarized ^{3}He was measured at 14 lab angles from 30 to 150°. The ^{3}He gas target was polarized by optical pumping techniques. A glass target with wide angle, thin Havar windows was developed which provided for observation of scattered protons as well as recoil ^{3}He. Previous experiments have been limited by an uncertainty of approximately 12 percent in the target polarization determined by optical measurements. In the present experiment a calibration measurement has reduced this uncertainty to 3.6 percent. The calibration measurement depends on a recently reported theorem which proves that the ^{3}He spin analyzing power of ^{4}He become –1.00 near 15.3 MeV and 86° center of mass. Values of the analyzing power for seven points in the energy-angle space near the above point were measured to determine the region where the analyzing power becomes equal to –1.00. Knowledge of the location of this region will allow future experimenters using polarized targets to significantly reduce the possible systematic errors mentioned above. The differential elastic scattering cross section was measured for ^{3}He(p,p)^{3}He at 26.70 MeV from 20 to 170° in the center of mass, to facilitate theoretical work. The ^{3}He spin analyzing power of 26.8-MeV protons is compared to a prediction based on phase-shift analysis. Although the data verify the major features of the phase-shift prediction, they distinctly disagree with the prediction in some details, thus they will be useful input data for future phase-shift search efforts. (Diss. Abstr. Int., B)

4883 NUCLEI AS GENERATORS OF QUASIREAL PHOTONS: TESTING AN EQUIVALENT–PHOTON METHOD FOR CALCULATING INVARIANT–MASS SPECTRA. Carimalo, C.; Cochard, G.; Kessler, P.; Parisi, J.; Roehner, B. (Laboratoire de Physique Corpusculaire, Collège de France, Paris, France). Phys. Rev. D 10: No. 5, 1561-1575 (1 Sept 1974).

It is shown that the equivalent–photon method (William–Weizsäcker method) can be used to predict, with a good approximation, the invariant–mass spectra produced in various processes of inelastic scattering of high–energy nonhadronic particles (photons, charged leptons, neutrinos) in the electromagnetic field of nuclear targets. The test cases here considered are $\gamma + \mathfrak{N} \rightarrow \mu + \bar{\mu} + \mathfrak{N}'$, $\mu + \mathfrak{N} \rightarrow \mu + \gamma + \mathfrak{N}'$, $\mu + \mathfrak{N} \rightarrow \mu + \gamma^* + \mathfrak{N}' \rightarrow \mu + \mu + \bar{\mu} + \mathfrak{N}'$, and $\nu + \mathfrak{N} \rightarrow \mu + W + \mathfrak{N}'$. The nuclear targets involved in this study are $_1H^1$ and $_{92}U^{235}$. On the target side, both coherent scattering (in the case of uranium) and elastic plus inelastic scattering of individual nucleons are included in the calculations. For all four processes, both target nuclei and all partial contributions considered (as well as for the sum of these contributions), we compare the exact and the approximate values obtained for $d\sigma/dW$, where W is the invariant mass of the system produced at the incident–particle vertex. A factorization formula, based on a helicity treatment, is used in the exact calculation; the equivalent–photon spectrum introduced is also derived from that formula. (auth)

4884 ASYMMETRY OF THE NUCLEON ANGULAR DISTRIBUTIONS IN THE REACTIONS ^{4}He(γ,p)^{3}H AND ^{4}He(γ,n)^{3}He FOR 65 ≤ E_γ ≤ 170 MeV. Noguchi, C.; Prats, F. (Department of Physics, George Washington University, Washington, D. C. 20006). Phys. Rev. Lett. 33: No. 19, 1168-1170 (4 Nov 1974).

The cross section for the reaction ^{4}He(γ,pnd) is calculated via the quasideuteron mechanism, assuming a ^{4}He Gaussian ground state fitted to the form factor. From the (γ,pnd) amplitude the contribution to the reactions ^{4}He(γ,p)^{3}H, ^{4}He(γ,n)^{3}He due to nd(pd) rescattering to form ^{3}H(^{3}He) are calculated. This contribution dominates the high–energy photonucleon cross section. An asymmetry coefficient β=1.51 at E_γ=120 MeV is obtained, close to the observed values. (auth)

4885 FAST NEUTRON DOUBLE SCATTERING ON ^{4}He. Tornow, W. (Tuebingen Univ. (F. R. Germany). Physikalisches Inst.). Z. Phys.; 266: No. 5, 357-365(Feb 1974).

11 figs.; 20 refs.

The asymmetry of 15 MeV neutrons has been measured after successive scattering from two high-pressure helium gas scintillators. The experimental result is compared with predictions of various n-^{4}He phase shift sets. The phases of Hoop and Barschall, Niller et al. and of Satchler et al. agree with the present experiment. (auth)

4886 ANGULAR DISTRIBUTION OF PROTONS FROM THE REACTION $^4He(e,e'p)^3H$. Gold'shtein, V. A.; Shostak, V. B.; Afanas'ev, N. G.; Vlasenko, V. G.; Kuplennikov, E. L.; Startsev, V. I. (Physical-Technical Inst., Kazan). Yadern. Fiz.; 20: No. 3, 447-448(Sep 1974). (In Russian).

The 1187-MeV electron beam is used to measure the angular distribution of protons from the reaction $^4He(e,e'p)^3H$. The parameter of the oscillator potential and the damping coefficient for 1S protons emitted by the ^4He nuclei are obtained. (auth)

4887 EFFECTS OF RECOIL AND CHARGE EXCHANGE IN ELASTIC SCATTERINGS OF PROTONS ON LIGHT NUCLEI ^3He, ^4He. Lykasov, G. I.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 3, 489-494(Sep 1974). (In Russian).

It is shown that at analysis of the elastic p^3He and p^4He scatterings ($T_p = 600$ MeV) an account of the recoil, and of that the trajectory of the incident particle inside the nucleus is not straight, contributes an additional phase-shift in the terms describing multiple collisions in the amplitudes. The result is an essential change of the proton polarizations in the p^3He and p^4He collisions near the minimum as well as at large momentum transfers. Sensibility of observables in the p^4He scattering ($T_p = 600$ MeV) to an account of two subsequent charge exchanges of the incident proton on the nucleons, $pn \rightarrow np$ and $np \rightarrow pn$, is also studied. (auth)

4888 ETUDE DES DIFFERENTES POSSIBILITES D'EXPLOITATION DE LA DISTRIBUTION EN ENERGIE DE PARTICULES CHARGEES ISSUES DE REACTION NUCLEAIRES PRODUITES LORS DU BOMBARDEMENT DE CIBLES EPAISSES PAR DES IONS LGERS DE FAIBLE ENERGIE (0.5 A 2.0 MeV). (Study of the Utilization Possibilities of the Energy Distribution of Charged Particles from Nuclear Reactions Due to the Bombardment of Thick Targets by Light Ions of Low Energy (0.5 to 2.0 MeV)). Weber, G. Liege; Univ. Liege (1974). 108p. Centre d'Etude de l'Energie Nucleaire, Mol, Belg.

Thesis.

The bombardment of light nuclei by low energy charged particles such as protons, deuterons, and helium-3 gives rise to a large range of nuclear reactions such as (d,p), (d,α), (p,α),... According to the balance of the reaction and the various excited states of the residual nucleus, these reactions can give rise to the emission of one or several groups of charged particles. The study and principally the energy spectra yield of particles in groups is the object of this work. The completion of the program WEGO 2145 constitutes the essential part of this work. It seems important to place emphasis on the manner of proceeding and especially to examine in detail the various parameters occurring in the course of the calculation. This leads to a double result: one was able to refine the technique of calculation so as to obtain a more and more satisfactory agreement between the experimental and calculated curves. Following an examination of the various contributions allowing an evaluation of the scattering affecting the energy spectra of the detected particles, the effects of the surface state on the irradiated samples are shown and evaluated; this is proven especially in the aluminium, this phenomenon being preponderant. Moreover, the method of calibration as well as that concerning the excitation curves of nuclear reactions will find an extension of their range of applicability in the plan of the next installation of the variable-energy cyclotron of the University of Liege. (JFP)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 3462, 4469, 4881, 4909, 4927, 4936, 4937, and 4939.

4889 (COO-1764-207) POSSIBLE COLLECTIVE EFFECTS IN THE POSITIVE PARITY PARTICLE-HOLE STATES OF ^{16}O. Ellis, P. J.; Osnes, E. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1973. Contract AT(11-1)-1764. 13p. Dep. NTIS $4.00.

The positive parity particle-hole states in ^{16}O were investigated in various TDA and RPA calculations. Their decay strength to ground was evaluated for general operators acting in orbital, spin and isospin space in order to search for possible collective effects. Some evidence was obtained for a weak collectivity for the hexadecapole state and some of the spin-multipole states, particularly in the case J = 2, T = 0, if a harmonic oscillator basis is used. (auth)

4890 (INTEL-RT-7011-001) (n,α) CROSS SECTIONS OF ^6Li AND ^{10}B BETWEEN 1 AND 1500 keV. Final Report. Friesenhahn, S. J.; Orphan, V. J.; Carlson, A. D.; Fricke, M. P.; Lopez, W. M. (Intelcom. Rad. Tech., San Diego, Calif. (USA)) 20 Feb 1974. Contract AT(04-3)-167. 69p. Dep. NTIS $6.50.

The $^{10}B(n,\alpha_0 + \alpha_1)^7Li$, $^{10}B(n,\alpha_1/^7Li^*)$, and $^6Li(n,\alpha)T$ cross sections were measured between 2.5 and 1500 keV neutron energy. The neutron spectrum was measured using proton scattering as observed in a methane-filled proportional counter. In an auxiliary measurement the ratio of the $^{10}B(n,\alpha_0 + \alpha_1)^7Li$ cross section to the hydrogen scattering cross section was obtained between 200 and 1000 keV by observation of interactions in a BF_3 counter containing a methane additive. The ^{10}B and ^6Li interactions were observed simultaneously in an ion chamber designed to minimize bias efficiency and multiple scattering corrections. This allowed a very precise $^{10}B/^6Li$ cross section ratio to be obtained. The present results supersede those reported previously. (auth)

4891 (STI/DOC-10/156, pp 325-473) EXCITATION FUNCTIONS FOR CHARGED-PARTICLE-INDUCED NUCLEAR REACTIONS IN LIGHT ELEMENTS AT LOW PROJECTILE ENERGIES. Lorenzen, J.; Brune, D. (Aktiebolaget Atomenergi, Studsvik, Sweden). 1974.

This compilation of data should be useful in various fields of nuclear applications, with the emphasis on charged-particle activation analysis. Activation analysis of light elements using charged particles has proved to be an important tool in solving various problems in analytical chemistry, e.g. those associated with metal surfaces. Scientists desiring to evaluate the distribution of light elements on the surface of various matrices by using charged-particle reactions require accurate data on cross sections in the MeV region. Also, a knowledge of cross-section data and yield functions is of great interest in many applied investigations involving work with charged particles, such as radiological protection and health physics, materials, research, semiconductor material investigations, and corrosion chemistry. The authors collected a limited number of data which find use in these fields. Although the compilation is far from being complete, it is expected to be of assistance in devising measurements of charged-particle reactions in Van de Graaff or other low-energy accelerators. (auth)

4892 EFFECTS OF THE NUCLEAR FORM-FACTOR IN PARTIAL AMPLITUDES OF THE STRIPPING REACTION. Orlov, Yu. V. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 3, 259-264(1974). (In Russian).

As an example of calculating partial amplitudes of the A(d,p) B reaction on ^{12}C and ^{16}O nuclei with a transition to the $2s_{1/2}$-state of the final nucleus at deuteron energies of 14, 50 and 100 MeV it is shown that the taking into account of the nuclear form factor (of the dependence on transmitted momentum in the peak part of $A + n \rightarrow B$) within the framework of the potential model leads to a noticeable decrease of partial amplitudes, even in the region of peripheral orbital momenta. (SJR)

4893 ANGULAR CORRELATION AND LIFETIME MEASUREMENTS IN ^{14}N AND ^{51}Mn. Noe, J. W. Philadelphia; Univ. of Pennsylvania (1974). 252p. University Microfilms Order No. 74-22,885.

Thesis (Ph. D.).

The properties of unbound states below 11-MeV excitation in ^{14}N and low lying bound states in ^{51}Mn were determined with angular correlation and lifetime experiments. In ^{14}N, angular correlations of the method II type were obtained for decay protons to the ^{13}C ground state. The ^{14}N states were populated with the $^{12}C(^3He,p)$ and $^{12}C(^6Li,\alpha)$ reactions. In addition, the γ-ray decays of the unbound states at 7.97 and 10.81 MeV were studied with the $^{12}C(^3He,p\gamma)^{14}N$ reaction. The results include definite spin-parity assignments of 4^- (8.49 MeV) and 5^+ (10.81 MeV). The latter state has $\Gamma_\gamma/\Gamma = 4.1 \pm 0.8\%$ and γ-ray decays >90% to the 6.44-MeV 3^+ state. The 7.97-MeV state has $J^\pi = (2^-)$ and $\Gamma_\gamma/\Gamma = (7 \pm 2) \times 10^{-3}$. This measured width ratio implies that $\Gamma(7.97)$ is ~100 times smaller than previously believed. The 9.13-MeV level is probably an unresolved doublet of states with $J^\pi = 2^-$ and 3^+. The results strongly support a recent weak-coupling model calculation for ^{14}N. The ^{51}Mn experiments were motivated by the expectation that (Z = 25) ^{51}Mn is analogous to (N = 25) ^{47}Ti and ^{49}Cr. In the γ-ray angular correlation and Doppler-shift attenuation measurements, states were populated with $^{54}Fe(p,\alpha)^{51}Mn$ reaction at $E_p \cong 12$ MeV. Alpha-particles were detected in a thin annular surface-barrier detector at angles near 180°, and the γ-rays were observed with an array of 4 NaI crystals or a 65 cm^3 Ge(Li) detector. J^π assignments are: 237.4-keV, $7/2^-$; 1139.5-keV, $9/2^-$; 1488.1-keV, $11/2^-$; 2415.9-keV, $7/2^-$. Fourteen lifetime values or limits were obtained for states below 3 MeV. Together with a recent result for the lifetime of the 237.4-keV level, the present measurements determine uniquely the strengths B(M1) and B(E2) of the $11/2^- \rightarrow 9/2^-(7/2^-)$, $9/2^- \rightarrow 7/2^-(5/2^-)$ and $7/2^- \rightarrow$ g.s. transitions. The transition rates and level energies are in good agreement with the predictions of a band-mixing calculation (deformation $\delta \cong 0.25$). Finally, the ^{40}Ca(^{16}O,pα) and ^{40}Ca(^{14}N,2pn) reactions were used to search for additional high spin states ($J > {}^{11}\!/_{2}$) in ^{51}Mn. Gamma-rays [(293.3), 429.7, 459.0, 723.0, 1468.5, 1761.8 and 1817.2 keV] observed in singles and γ-γ coincidence imply the existence of previously unknown levels at 2956.7, 3250.0, 3679.7 and 4138.7 keV. (Diss. Abstr. Int., B)

4894 ^{6}Li(α,d)^{8}Be REACTION IN THE REGION OF ALPHA ENERGIES FROM 12 TO 25 MeV. Kostyuchenkov, S. D.; Lebedev, V. M.; Spasskii, A. V.; Teplov, I. B. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 4, 424-431(1974). (In Russian).

Measurements were taken of the angular and energy dependencies of the differential cross sections of the ^{6}Li(α,d)^{8}Be reaction with the formation of the ground (0+) and the first excited (2.9 MeV, 2^{+}) states of the first nucleus. The measurements were carried out in the interval of angles $\theta_{lab} = 20$ to 170° and in the region of α-particle energies from 12 to 25 MeV. It is proposed that the basic mechanisms of the reaction under study are replacement of the deuteron cluster by an α particle and breakup of the heavy particle. (SJR)

4895 DIRECT REACTIONS OF FAST–FRAGMENT KNOCK–OUT BY HIGH–ENERGY PROTONS. Komarov, V.I. (Joint Institute for nuclear Research, Dubna). Sov. J. Part. Nucl. 5: No. 2, 168-191 (Oct 1974).

A survey is presented of the experimental research on the direct nuclear A (p, pX) reactions, where $X \equiv d$, ^{3}H, ^{3}He, and ^{4}He, at proton energies ~0.2–1.0 GeV. The physical interpretation of the data obtained in such reactions is discussed. (auth)

4896 MEASUREMENT OF EXCITATION FUNCTIONS FOR PARTICLE ELASTIC SCATTERING BY LIGHT NUCLEI, USING ACCELERATORS WITH FIXED ENERGY. Zaika, N. I.; Mokhnach, A. V.; Semenov, V. S.; Shmarin, P. L. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 7, 1136-1142(Jul 1974). (In Russian).

A method is described to measure excitation functions for elastic scattering, using accelerators with fixed energy. The kinematics peculiarities for elastic scattering allow excitation functions to be obtained for light nuclei ($A \lesssim 20$), using energy spread of incident particles and coincidence of scattered particle with recoil nuclei. The experimental apparatus is described. The results of the excitation function measurements for d + ^{12}C and α + ^{12}C elastic scattering are presented. (auth)

4897 MEASUREMENT OF CHARGED–PION PRODUCTION BY 7.28–GeV NITROGEN IONS. Schimmerling, W.; Vosburgh, K. G.; Koepke, K. (Princeton Particle Accelerator, Princeton University, Princeton, New Jersey 08540); Wales, W. D. Phys. Rev. Lett. 33: No. 19, 1170-1173 (4 Nov 1974).

Cross sections for charged–pi–meson production by 7.28–GeV nitrogen ions on elemental targets were measured at a laboratory angle of 15° at the Princeton Particle Accelerator. At pion energies of ~260 and ~415 MeV, the data show the $A^{1/3}$ dependence predicted by an "effective number of nucleons" model. For π^{-} energies above ~415 MeV, the measured cross sections exceed those calculated from nucleon–nucleus data, even after the inclusion of Fermi–motion effects. (auth)

4898 BRANCHING RATIO IN THE DECAY OF BERYLLIUM-7. Goodier, I. W.; Makepeace, J. L.; Williams, A. (National Physical Lab., Teddington, Eng.). Int. J. Appl. Radiat. Isotop.; 25: No. 8, 373-376(Aug 1974).

The branching ratio for the decay ^{7}Be to the 477 keV level in ^{7}Li has been determined from measurements of the absolute disintegration rate and γ-quanta emission rate for each of ten mass-separated sources. The absolute disintegration rate measurements were carried out using the $4\pi\beta-\gamma$ coincidence technique, and the γ-quanta emission rates were obtained in a calibrated sodium iodide well crystal. A value of 0.1035 was obtained with a standard error of 0.0001 (nine degrees of freedom) and a systematic uncertainty of ±0.0008. (auth)

4899 POLARIZATION OF SHORT-LIVED STATES IN ELECTROEXCITATION REACTIONS. Narodetskii, I. M.; Grach, I. L. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 11,360-362 (5 Jun 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 11, 698-703(5 Jun 1974).

The polarization of the short-lived states in electroexcitation reactions was calculated; measurement of this polarization makes it possible to determine the relative phase of the off-diagonal matrix elements and the static moments of the short-lived states. The excitation of the ${}^{1}\!/_{2}{}^{+}$ level in the reaction ^{7}Li(e, e′)^{7}Li* is considered as an example. The main contribution is due to the Mott rescattering and to the interference of the C 2 and M 1 transitions, and amounts to $\sim 6 \times 10^{-12}$ at the maximum. The contribution of the magnetic moments is $\sim 3 \times 10^{-6}$. (auth)

4900 CONNECTION BETWEEN THE VERTEX CONSTANTS AND THE ELECTROMAGNETIC FORM FACTORS OF NUCLEI. Blokhintsev, L. D. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 19: No. 11, 362-363(5 Jun 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 11, 703-707(5 Jun 1974).

It is assumed that the main contribution to the rapidly varying part of the charge form factors of nuclei at low momentum transfers q is made by amplitudes of Feynman triangle diagrams having singularities in q closest to the physical region. Under this assumption, it is possible to express the vertex constants G_{dnp} and $G_{Li^{6}\alpha d}$ for the decays $d \to n + p$ and $^{6}Li \to \alpha + d$ in terms of the experimental charge radii of ^{2}H and ^{6}Li, thus obtaining $G^{2}_{dnp} = 0.43$ F and $G_{Li^{6}\alpha d} = 0.13$ F. (auth)

4901 NEUTRON POLARIZATIONS FROM THE ^{9}Be(d,n)^{10}B AND ^{11}B(d,n)^{12}C REACTIONS. Thornton, S. T.; Jordan, R. C.; Morris, C. L.; Rotter, R. P. (Virginia Univ., Charlottesville (USA). Dept. of Physics). Z. Phys.; 266: No. 5, 329-336(Feb 1974).

6 figs.; 1 tab.; 27 refs.

Neutron polarization angular distributions were measured for the ^{9}Be(d,n)^{10}B and ^{11}B(d,n)^{12}C reactions for deuteron energies of 5.47 and 5.34 MeV, respectively. Using neutron time-of-flight techniques, polarizations to eight states in ^{10}B and to six states in ^{12}C have been measured. Neutron polarization energy excitation functions for both reactions were measured for deuteron energies from 3.0 to 5.5 MeV in 0.25 MeV steps at 30° (lab). Distorted wave method calculations carried out to compare theoretical calculations against experimental results were not in good agreement with the data. (auth)

4902 MULTIPION PRODUCTION WITH SIMULTANEOUS EXCITATION OF DISCRETE NUCLEAR LEVELS. Lesniak, H.; Lesniak, L. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol., 5B: No. 5, 703-724(1974).

Production processes of multihadron systems leading to the excitation of the discrete nuclear levels are studied in the framework of the distorted wave impulse approximation model. The influence of the nuclear absorption of the outgoing multiparticle system on the effective mass and momentum transfer distributions is examined. Amplitudes for the process $\pi^{12}C \to \pi\pi\pi^{12}C^{*}$ (4.4 MeV) are derived, and the results compared with experimental data. (auth)

4903 EFFECT OF EXCITED-STATE DECAYS ON THE MEASURED ANGULAR DISTRIBUTION OF THE ^{12}C(γ,p)^{11}B REACTION. Dixon, J. M. (Univ. of Melbourne); Thompson, M. N. Aust. J. Phys.; 27: No. 3, 301-306(Jun 1974).

The angular distribution of photoprotons from ^{12}C as measured directly and as deduced from the inverse reaction are compared. A discrepancy is revealed; it is resolved by proposing a small cross section for proton decay to excited states of ^{11}B. The size of this cross section is inferred from the data. (auth)

4904 GIANT DIPOLE RESONANCE OF ^{16}O. Wang, W. L. (Univ. of California, Berkeley). Chin. J. Phys. (Taiwan); 12: No. 1, 35-36(Apr 1974).

A comment is made on the calculation of Wang et al. [Chinese J. of Phys. (Taipei) 11, 65 (1973)], where admixture of $3\hbar\omega$ excitations in the dipole resonance of ^{16}O was considered. (auth)

4905 REACTION ^{9}Be(e,e′p)^{8}Li WITH REGISTRATION OF (e,p) COINCIDENCES. Gol'dshtein, V. A.; Shostak, V. B.; Afanas'ev, N. G.; Vlasenko, V. G.; Kuplennikov, E. L.; Startsev, V. I. (Physical-Technical Inst., Kharkov). JETP Lett. (USSR) (Engl. Transl.); 19: No. 11, 358-359(5 Jun 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 11, 695-697(5 Jun 1974).

A beam of 801-MeV electrons from the LUÉ-2000 accelerator was used to measure the cross section of the reaction ^{9}Be(e,e′p)^{8}Li as a function of the proton detachment energy. The values obtained for the detachment energies of the 1S- and 1P-protons are 28.7 and 16.9 MeV, respectively. (auth)

4906 MEASUREMENT OF THE EFFECTIVE CROSS SECTIONS FOR THE NONELASTIC INTERACTIONS OF PROTONS WITH CARBON AND HYDROGEN NUCLEI IN THE ENERGY RANGE FROM 20 TO 600 GeV ON THE PROTON-1, -2, AND -3 SPACE STATIONS. Grigorov, N. L.; Nesterov, V. E.; Rapoport, I. D.; Savenko, I. A.; Skuridin, G. A. pp 10-33 of Izuchenie Kosmicheskikh Luchei na Iskusstvennykh Sputnikakh Zemli. Shtern, M. I. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Nuclear Properties and Reactions, $20 \leq A \leq 38$

Refer also to abstracts 4873, 4897, 4916, 4927, 4936–4940, and 4959.

4907 ERICSON FLUCTUATIONS IN THE CROSS SECTION OF $^{28}\mathrm{Si}(n,\alpha)^{25}\mathrm{Mg}$ REACTION. Siddiq, A. K. M. (Dacca Univ., Bangladesh); Awal, A.; Khan, A. K.; Islam, M. M.; Rahman, F.; Sanaullah. Indian J. Phys.; 48: No. 4, 318-323(Apr 1974).

The relative cross section of the $^{28}\mathrm{Si}(n,\alpha)^{25}\mathrm{Mg}$ reaction for transitions to the ground, second, third, and fourth excited states of the residual nucleus, ^{25}Mg, were measured as a function of the neutron energy in the range of 12.6 to 17.8 MeV at intervals of 40 to 80 keV; a solid-state semiconductor Si detector was used. The fluctuations in cross sections for transitions to various final states of the residual nucleus were also calculated, and the experimental results were compared with Ericson's predicted fluctuations. The experimental values differ by a factor of 2 from those predicted by Ericson. (2 figures, 1 table). (auth)

4908 GAMMA RAYS FROM FUSION-EVAPORATION REACTIONS IN $32 \leq A < 46$ NUCLEI. Warburton, E. K.; Kolata, J. J.; Olness, J. W.; Poletti, A. R.; Gorodetzky, P. (Brookhaven National Lab., Upton, NY). At. Data Nucl. Data Tables; 14: No. 2, 147-160(Aug 1974).

Tables are presented for observed properties of the nuclear gamma rays emitted following the bombardment of ^{24,26}Mg, ^{27}Al, and ^{28}Si targets with ^{14}N, ^{16,18}O, and ^{19}F beams. Energy, emitting nucleus, intensity, and angular-distribution coefficients are listed for each gamma where known. The beam energies were between 20 and 60 MeV. The gamma rays are from various final nuclei produced by the fusion of projectile and target nuclei into a compound nucleus and the subsequent evaporation of a few light particles. (11 tables) (auth)

4909 SHELL-MODEL CALCULATIONS IN THE SD SHELL. I. Energy Spectra. Cole, B. J.; Watt, A.; Whitehead, R. R. (Univ. of Glasgow). J. Phys., A (London); 7: No. 12, 1374-1398 (11 Aug 1974).

Shell-model calculations have been performed for a number of nuclei in the sd shell to obtain binding energies and energy spectra. The realistic interactions of Kuo (Nucl. Phys. A.; 103: 71-96 (1967)), and Elliott et al. (Nucl. Phys. A.; 121: 241-78 (1968)), and the empirically determined matrix elements of Preedom and Wildenthal (Phys. Rev. C: 6; 1633-44 (1972)) were used in the full sd shell basis. Comparison with experiment shows that the Preedom–Wildenthal interaction works well in the lower part of the shell, whereas the outer two give rise to shifts of whole rotational bands in most nuclei. (auth)

4910 SHELL-MODEL CALCULATIONS IN THE SD SHELL. II. Mass Excesses and Energy Spectra of Exotic Nuclei. Cole, B. J.; Watt, A.; Whitehead, R. R. (Univ. of Glasgow). J. Phys., A (London); 7: No. 12, 1399-1409(11 Aug 1974).

Calculations of binding energies and energy spectra have been performed for a number of neutron- and proton-rich (exotic) nuclei in the sd shell using the Kuo (Nucl. Phys. A.; 103: 71-96 (1967)) and Preedom and Wildenthal (Phys. Rev. C.; 6: 1633-44 (1972)) interactions. It is found that the Preedom–Wildenthal interaction reproduces the binding energies very well, even when used for masses greater than those for which it was derived. A number of mass and spin predictions are made in cases where as yet no data are available. (auth)

4911 GAMMA-RAY SPECTROSCOPY IN ^{31}P: LEVELS BELOW 7.5 MeV. Twin, P. J.; Jayasinghe, E. M.; Jones, G. D.; Lornie, P. R. G.; Nagel, A.; Price, H. G.; Thomas, M. F. (Univ. of Liverpool). J. Phys., A (London); 7: No. 12, 1410-1436(11 Aug 1974).

Gamma-ray angular distributions have been measured following the $^{28}\mathrm{Si}(\alpha, p\gamma)^{31}\mathrm{P}$ reaction by using both NaI(Tl) crystals, in coincidence with an annular particle telescope, and Ge(Li) detectors. Lifetimes have been determined using the DSAM and γ-ray polarizations measured using a 3 Ge(Li) Compton polarimeter. New definite spin assignments include $\frac{5}{2}^{+}$ (5115 keV state), $\frac{7}{2}^{+}$ (4634 and 6048 keV states), $\frac{9}{2}^{+}$ (5343, 5892, 6081 and 7118 keV states), $\frac{11}{2}^{+}$ (6453 and 7441 keV states), $\frac{3}{2}^{-}$ (5010 keV state), $\frac{9}{2}^{-}$ (6500 and 6793 keV states) and $\frac{11}{2}^{-}$ (6825 keV state). Many multipole mixing ratios, lifetimes and new branching ratios are reported. An interpretation of the positive-parity states is proposed based on the strong-coupling and rotation–vibration models. A striking feature in the spectrum of the negative-parity states is pointed out which suggests particle–phonon coupling is important. Shell-model calculations based on the MSDI interaction have been extended to include the transition strengths from higher-spin positive-parity states. (auth)

4912 PROPERTIES OF LOW-LYING LEVELS IN ^{37}Cl. Nolan, P. J.; Gadeken, L. L.; Brown, A. J.; Butler, P. A.; Green, L. L.; James, A. N.; Sharpey-Schafer, J. F.; Viggars, D. A. (Univ. of Liverpool). J. Phys., A (London); 7: No. 12, 1437-1447(11 Aug 1974).

Excitation energies, mean lifetimes, gamma-ray branching ratios, angular correlations and linear polarizations have been measured for levels below 5.3 MeV in ^{37}Cl. The states were populated using the $^{34}\mathrm{S}(\alpha, p\gamma)^{37}\mathrm{Cl}$ reaction at bombarding energies between 9.0 MeV and 12.2 MeV. A γ–γ coincidence experiment was performed at 11.5 MeV to obtain the decay scheme. New measurements were made for the following levels: $E_x(\tau_m)J^{\pi}$; 3087 keV (<40 fs) $\frac{5}{2}^{+}$; 3015 keV (48 ± 5 ps) $\frac{7}{2}^{-}$; 3626 keV (40 ± 20 fs) $\frac{3}{2}$, $\frac{5}{2}$, $\frac{7}{2}^{+}$; 3708 keV (<25 fs) $\frac{3}{2}^{+}$, $\frac{5}{2}^{-}$; 3740 keV (<20 fs) $\frac{5}{2}^{-}$; 4011 keV (31 ± 3 ps) $\frac{9}{2}^{-}$; 4547 keV (2.7 ± 0.6 ps) $\frac{11}{2}^{-}$; and 5271 keV (2.7 ± 0.4 ps) $\frac{13}{2}^{-}$. The results are compared with the properties of high-spin negative-parity states in neighbouring nuclei and are discussed in terms of recent shell-model calculations. (auth)

4913 GAMMA-DECAY OF THE LOWEST $T = \frac{3}{2}$-STATE OF ^{33}Cl. Abbondanno, U. (Univ., Trieste, Italy); Poiani, G.; Blasi, P. Lett. Nuovo Cim.; 11: No. 10, 481-485(9 Nov 1974).

In order to obtain more defined information on the lowest $T = \frac{3}{2}$ state in chlorine-33 ($J^{\pi} = \frac{1}{2}^{+}$, E_x = 55558 keV), reached through the $^{32}\mathrm{S}(p,\gamma)^{33}\mathrm{Cl}$, its gamma decay was investigated. Strong evidence for the presence of the two gamma rays resulting from the decay of the analogous $J^{\pi} = \frac{1}{2}^{+}$, $T = \frac{3}{2}$ state to the first $\frac{1}{2}^{+}$, $\frac{1}{2}$ excited state of chlorine-33 and to the ground state $\frac{3}{2}^{+}$, $\frac{1}{2}$ of the same nucleus. The gamma-decay of the first excited level to the ground state with E_{γ} = 809 keV is also present. The branching ratio was obtained for the decay of the $T = \frac{3}{2}$ state. Also the radiative widths of the transitions were derived through the determination of the resonance strength. (JFP)

4914 EXCITATION OF GAMMA VIBRATIONAL STATE OF ^{25}Mg BY ELECTRON SCATTERING. Okazaki, Y.; Oyamada, M.; Terasawa, T.; Nakahara, K.; Hayakawa, K. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 6: No. 2, 225-234(Dec 1973). (In Japanese).

A study on the γ vibrational state of ^{25}Mg was performed by electron scattering experiment. The target used was ^{25}Mg enriched to 99.21%. Incident energy of electrons was 120, 150 and 250 MeV. Scattered electrons were measured at the angle from 35 to 120°. Absolute values of the elastic scattering cross section of ^{25}Mg were determined so that the form factor F(q) became one when q_2 approached to zero. One of the obtained spectra of scattered electrons corrected for bremsstrahlung is shown. Obtained values of γ-ray transition probability B (E λ) are tabulated in a table. The square of the form factor F for ground rotational state was obtained. Quadrupole moment for each state was also calculated. The form factor for the ground state ($\frac{5}{2}$ +), and the states $\frac{7}{2}$ +, and $\frac{9}{2}$ + was almost same, and the rotational model was considered to be good approximation. A rotational band of $\frac{1}{2}_{2}$ + state starting from 2.56 MeV was explained as a band produced by the combination of a neutron of $Q = \frac{5}{2}$ with a γ vibrational core of ^{24}Mg. Branching ratio and transition probability of γ-ray can be explained well by the interpretation. The existence of $K = \frac{1}{2}_{1}$ and $K = \frac{9}{2}$ bands, which were formed by the combination of a neutron of $Q = \frac{5}{2}$ with a core of the $K^{\pi} = 2^{+}$ rotational band of ^{24}Mg, was suggested from the present results. (Kato, T.)

4915 ABSOLUTE NORMALIZATION OF SPECTROSCOPIC FACTORS FOR PROTON TRANSFER REACTIONS ON ^{35,37}Cl. Clement, C. F.; Perez, S. M. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., A (London); 7: No. 12, 1464-1473(11 Aug 1974).

Spin-dependent sum rules for spectroscopic factors have been fitted to proton $s_{1/2}$ and $d_{3/2}$ spectroscopic factors obtained from (d,^{3}He) and (^{3}He,d) reactions on ^{35,37}Cl. The fits with suggested spin assignments show deep minima in a plot of expected error in relative spectroscopic factors against absolute magnitude of the spectroscopic factors. Thus, if the relative spectroscopic factors have a 10% error, the absolute magnitudes are determined to about ±6%. The reduction in pick-up spectroscopic factors on ^{37}Cl found by analyzing one set of experimental data is in agreement with more recent (d,^{3}He) data. Theoretical wavefunctions for ^{35}Cl are examined in the light of the results obtained. (auth)

Nuclear Properties and Reactions, $39 \leq A \leq 58$

Refer also to abstracts 3536, 4893, 4897, 4927, 4928, 4931, and 4936–4940.

4916 (BNL-19196) REVIEW OF CORRELATION DATA: DEPARTURES FROM THE STATISTICAL MODEL. Mughabghab, S. F. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 26p. (CONF-740920-13). Dep. NTIS $4.50.

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

Gamma-ray spectra due to radiative neutron capture in the thermal and resonance region are examined for nonstatistical effects. The data appear to be consistent with the interpretation that generally direct hard-sphere capture dominates in the thermal region for $A \leq 46$, while valence capture plays a significant and sometimes dominant role in the vicinity of the peaks of the 2P, 3S, and 3P single-particle giant resonances. Additional evidence of valence capture is provided by data on ^{24}Mg, ^{36}Ar, and ^{54}Fe. On the other hand, correlations between partial radiative widths and either the (d,p) spectroscopic factors or the reduced neutron widths are reported. Since the magnitude of the valence neutron contribution cannot account for these observations, the doorway state picture is invoked. (18 figures) (auth)

4917 (LYCEN-7346) STUDY OF ^{44}Sc, ^{46}Sc, AND ^{52}Mn NUCLEI FROM DOUBLE TRANSFER REACTIONS. Guichard, A. (Lambda Corp., Arlington, Va. (USA)). Jul 1973. 120p. (In French). Dep. NTIS (US Sales Only) $9.00.

Thesis.

The ^{44}Sc and ^{52}Mn nuclei conjugated in the framework of the $f^{n}_{7/2}$ model were studied together with the ^{46}Sc nucleus. Double transfer reactions were used for this purpose. The following experiments were performed: ^{46}Ti(d, α) at 26.7 MeV and ^{42}Ca (tau, p) at 35 MeV for ^{44}Sc; ^{48}Ti (d, α) at 26.7 MeV for ^{46}Sc; ^{54}Fe (d, α) at 28 MeV and 15 MeV, ^{50}Cr (tau, p) at 35 MeV, and ^{50}Cr (α, d) at 31.2 MeV for ^{52}Mn. In general very high incident energies were used. This characteristic combined with the large Q values associated with the reactions tended to favor the revealing of levels with large orbital angular momenta. A description is given of the experimental details used in each of these experiments. Double transfer reaction formalisms are reviewed together with a description of some methods for calculating the form factors of transferred nucleon. The effect of the choice of optical potential on the angular distributions and the effect of this potential on the localization of reactions are mentioned. In addition, the effect of parameters obtained using various methods to calculate the form factors on the angular distributions is analyzed. The experimental results for ^{44}Sc and ^{46} Sc are studied and analyzed in the framework of the Glendenning formalism. The ^{42}Ca (tau, p)^{44}Sc reaction is interpreted in the framework of the shell model in an $f_{7/2}$-$2p_{3/2}$ base space. The results obtained on ^{52}Mn are presented together with their interpretation. (auth)

4918 LIFETIMES OF LEVELS IN ^{46}Ti. Durell, J. L.; Dracoulis, G. D.; Gelletly, W. (Univ. of Manchester, Eng.). J. Phys., A (London); 7: No. 12, 1448-1450(11 Aug 1974).

The reaction ^{43}Ca(α,n)^{46}Ti was used to populate levels in ^{46}Ti at α particle energies of 6.5 and 7.5 MeV. Gamma rays in ^{46}Ti were observed in a Ge(Li)−NaI(Tl) escape-suppressed spectrometer. The Doppler shift attenuation method was used to measure the mean lifetimes of 10 levels in ^{46}Ti. The $J^{\pi} = 0^{+}$, 2.61-MeV level is shown to have an enhanced E2 transition to the first excited 2^{+} state. (auth)

4919 QUASI-ELASTIC ELECTRON SCATTERING. I. The Coulomb Excitation Functions for ^{40}Ca and ^{197}Au. Kawazoe, Y. (Tohoku Univ., Japan). Kakuriken Kenkyu Hokoku; 6: No. 2, 216-224(Dec 1973).

A new model for quasi-elastic electron scattering was introduced, and applied for ^{40}Ca and ^{197}Au. The quasi-elastic electron scattering in a square well shell model was treated by Donnelly; all the contributions of single particle-hole excitation from bound hole to continuum particle state to differential cross section were summed up. Although good agreement with experiment was obtained for ^{12}C, the model did not work well for ^{40}Ca, because of the narrow peaks associated with resonant g-wave. The spin-orbit force determined by fitting to experimental data was introduced. The present model was applied to ^{40}Ca at several values of incident energy and angle. The square-well parameters taken were range Ro = 4.55 fm and depth Vo = 37.36 MeV, and the spin-orbit force is fixed as $\langle \nu \ \widehat{(\gamma)} \rangle = -2.3$ MeV. In the present phenomenological $\vec{l}.\vec{s}$ force model, $1f_{5/2}$ level is unbound, but the wave function for this level has some shape for bound state. Considerable informations for ^{40}Ca can be obtained by this model. The calculation for the quasi-elastic cross section for ^{197}Au was also performed. At first, the filling up to 2 $d_{3/2}$ level was considered, and after that, the resulting cross section associated with 2 $d_{3/2}$ level was multiplied by $^{3}/_{4}$. The results were found to be successful. (JA)

4920 MEASUREMENT OF STATIC ELECTRIC QUADRUPOLE MOMENTS IN ^{42,44}Ca, ^{46,50}Ti, ^{50,52,54}Cr, AND ^{58}Fe. Towsley, C. W. Rochester, NY; Univ. of Rochester (1974). 265p. University Microfilms Order No. 74-22,636.

Thesis (Ph. D.).

The static electric quadrupole moments Q_{2}^{+} of the first excited (2_{1}^{+}) states of ^{42,44}Ca, ^{46,50}Ti, ^{50,52,54}Cr and ^{58}Fe were measured using the reorientation effect in Coulomb excitation. Reduced transition probabilities B(E2;g.s. $\rightarrow 2_{1}^{+}$) for Coulomb excitation of these states were also measured. Thin targets of the separated isotopes were bombarded with 55 to 62-MeV ^{32}S ions, except for ^{58}Fe where 76-MeV ^{40}Ca ions were used. Scattered projectiles and recoiling target nuclei were detected in coincidence with de-excitation γ-rays in a multiple particle-γ-ray coincidence technique using four NaI(Tl) detectors for the γ-rays and four silicon surface barrier detectors for the particles. The particle detectors were placed at forward angles, permitting simultaneous collection of data at eight widely separated scattering angles in the center-of-mass reference frame. (Diss. Abstr. Int., B)

4921 OBSERVATIONS OF HIGH−SPIN YRAST CASCADE IN ^{50}Cr. Kutschera, W.; Huber, R.B.; Signorini, C.; Morinaga, H. (Physik Department der Technischen Universität München, 8046 Garching, Germany). Phys. Rev. Lett. 33: No. 18, 1108-1112 (28 Oct 1974).

A ground−state band with spin up to $J^{\pi} = 12^{+}$ was observed in ^{50}Cr from the reactions ^{40}Ca(^{16}O, 2pα)^{50}Cr, ^{24}Mg(^{32}S, 2pα)^{50}Cr, ^{40}Ca(^{14}N, 3pn) ^{50}Cr, and ^{40}Ca(^{12}C, 2p)^{50}Cr. Spin and parity assignments were made from $\gamma-\gamma$ coincidences, angular distributions, and linear−polarization measurements. The higher−spin states are reasonably well reproduced in the $(1f_{7/2})^{n}$ shell−model frame while discrepancies exist for the lower ones. These levels have collective features at lower excitation but very pure shell−model characteristics towards the maximum spin expected in the $(1f_{7/2})^{n}$ space. (auth)

4922 PRODUCTION OF LIGHT FRAGMENTS IN THE INTERACTION OF 1-GeV PROTONS WITH SILVER NUCLEI. Vol'nin, E. N.; Vorob'ev, A. A.; Seliverstov, D. M. (Leningrad Inst. of Nuclear Physics). JETP Lett. (USSR) (Engl. Transl.); 19: No. 11, 357-358(5 Jun 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 11, 691-694(5 Jun 1974).

The energy spectra of light fragments with $2 \leq z \leq 5$ produced when 1-GeV protons interact with silver nuclei were measured, and their production cross section measured. The results are analyzed on the basis of the evaporation model. (auth)

4923 STUDY OF LEVELS IN ^{55}Mn BY COULOMB EXCITATION. Kulkarni, R. G.; Nainan, T. D. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Can. J. Phys.; 52: No. 17, 1676-1682(1 Sep 1974).

The first five excited levels in ^{55}Mn were studied by means of Coulomb excitation by alpha particles varying in energy from 5 to 7 MeV. The Coulomb character of these levels in ^{55}Mn was confirmed by comparing thick target yields to the theoretical predictions. The reduced E2 transition probabilities $B(E2)_{\uparrow}$ were obtained for these five levels from thick target yields. The gamma-gamma coincidences were measured to identify cascade gamma transitions and branching ratios. The experimentally found $B(E2)_{\uparrow}$ values were compared with the theoretical calculations of two different authors. (auth)

4924 REACTION ^{56}Fe(γ,n)^{55}Fe NEAR THE THRESHOLD. Abramov, A. I.; Kitaev, V. Ya.; Yutkin, M. G. Yadern. Fiz.; 20: No. 3, 438-446(Sep 1974). (In Russian).

Effective cross sections of the reaction ^{56}Fe(γ,n)^{55}Fe are measured by means of the time-of-flight method in the neutron energy range from 1 up to 136 keV. Energies of 14 resonances were measured. For four resonances the main parameters are derived: E^{0}_{L}, σ_{0}, Γ, $\Gamma_{\gamma 0}$. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 4897, 4916, 4933, 4936—4941, 4949, 4959, and 4989.

4925 (KFK-1951) TOTAL CAPTURE CROSS SECTION OF ^{59}Co IN THE NEUTRON ENERGY REGION 6 TO 200 keV. Spencer, R. R.; Beer, H. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Aug 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

The neutron capture cross section of ^{59}Co was measured in the energy range from 6 to 200 keV using an 800 l liquid scintillator detector in conjunction with a pulsed, 3 MV Van de Graaff. The excellent time resolution of the system (FWHM = 2.8 ns) permitted derivation of radiation widths for single s-wave resonances to 50 keV neutron energy. Average radiation widths of 0.564 ± 0.024 and 0.486 ± 0.016 eV were found for seven J = 3 resonances and ten J = 4 resonances, respectively. No significant correlation between Γ_n^0 and Γ_γ was found for either spin state. The Maxwellian averaged cross section for kT = 30 keV was found to be 72 mb over the region from thermal to 200 keV neutron energy. (auth)

4926 (RCN-214) INVESTIGATION OF THE REACTION ^{50}Cr (n, γ)^{51}Cr. Kopecky, J. (Stichting Reactor Centrum Nederland, Petten). Sep 1974. 27p. Dep. NTIS (US Sales Only) $4.50.

Gamma rays following thermal-neutron capture in a ^{50}Cr enriched target were studied with a Ge(Li) detector. A total of 71 γ-rays was ascribed to the studied reaction, 60 of which could be placed into a ^{51}Cr decay scheme. The excitation energies of 25 levels were determined with 0.12 to 0.7 keV errors. The reaction Q-value is (9261.7 ± 0.7) keV. The reaction mechanism is discussed in the frame of the valency neutron approach. (auth)

4927 (STI/DOC-10/156, pp 273-324) CROSS-SECTIONS FOR FISSION NEUTRON SPECTRUM INDUCED REACTIONS. Calamand, A. (International Atomic Energy Agency, Vienna). 1974.

A review is given of cross sections averaged in a uranium-235 fission neutron spectrum. The review extends to all integral measurements available in the literature up to April 1973 for (n,p), (n,α), (n,2n), and (n,n′) reactions. Whenever possible, the cross sections were renormalized to a standard value of 1250 ± 70 mb for the uranium-235 fission cross section averaged in the thermal fission neutron spectrum of uranium-235. Recommended values were attributed. Furthermore, averaged (n,p), (n,α), and (n,2n) cross sections were estimated for all stable and a few long-lived isotopes. (4 figures, 6 tables, 105 references) (auth)

4928 (ZFK-265) LEVEL SCHEME OF ^{59}Cu AND THE IAR DECAY AS STUDIED BY THE ^{58}Ni(p,γ)^{59}Cu REACTION. Rudolph, W.; Gippner, P.; Kleinwaechter, P.; Klar, E.; Koch, R.; Kissener, H. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Oct 1973. 19p. Dep. NTIS (US Sales Only) $4.00.

The γ decay of the E_p = 1376, 1424, 1663, 1716 and 1844 keV resonances in the ^{58}Ni(p,γ)^{59}Cu reaction was studied by using a Ge(Li) detector. By means of gamma cascades the excitation energies 4769.9, 4818.0, 5051.7, 5103.6 and 5230.9 keV were obtained for these resonances. For the proton binding energy the value of 3418.6 keV was obtained. Positions and decay modes of ^{59}Cu levels are compared with the results of shell-model calculations; a satisfactory agreement was found. The deexcitation of the isobaric analog resonances can be explained qualitatively by means of simple model calculations. (3 figures, 9 tables). (auth)

4929 LOW-ENERGY GAMMA-RAY SPECTRUM OF ^{75}Se. Campbell, J. L. (Guelph Univ., Ont.). J. Phys., A (London); 7: No. 12, 1451-1453(11 Aug 1974).

The γ-ray spectrum of ^{75}Se below 30 keV has been recorded with a guard-ring Si(Li) spectrometer. No evidence was found to support a recent observation of 14.9 keV γ ray; the upper limit for its intensity was 0.0017 relative to Iγ(264.6 keV) = 100. (auth)

4930 A STUDY ON THE DECAY OF ^{81}As. Chacko, M. C.; Heyde, K.; Dorikens-Vanpraet, L.; Dorikens, M. (Ghent Rijksuniversiteit (Belgium)). Z. Phys.; 266: No. 5, 337-345(Feb 1974).

8 figs.; 4 tabs.; 10 refs.

The decay of ^{81}As was investigated with Ge(Li) spectrometers. Accurate energy and intensity determinations for 29 gamma rays have been performed, from which a level scheme was deduced for ^{81}Se. Beta component intensities were obtained from the measured gamma intensities. Spin and parity assignments for most of the levels were made in agreement with the reaction and neutron capture studies. The half life of ^{81}As is measured to be (35.8 ± 1.6) sec. Shell model calculations as well as unified model calculations have been performed in order to study the level scheme of ^{81}Se. (auth)

4931 CROSS SECTIONS FOR THE REACTIONS ^{66}Zn(d,n)^{67}Ga, ^{52}Cr(d,2n) ^{52g}Mn AND ^{186}W(d,2n)^{186}Re. Nassiff, S. J.; Muenzel, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Radiochemie). Radiochim. Acta; 19: No. 3, 97-99(1973).

2 figs.; 3 tabs.; 18 refs.

Experimental cross sections for the reactions ^{66}Zn(d,n)^{67}Ga, ^{52}Cr(d,2n) ^{52g}Mn, and ^{186}W(d,2n)^{186}Re are reported. The values obtained are compared with the cross sections expected from the systematics. (auth)

4932 PHOTONEUTRON CROSS SECTIONS FOR ^{64}Zn AND ^{68}Zn IN THE GIANT DIPOLE RESONANCE REGION. Ishkhanov, B. S.; Kapitonov, I. M.; Lazutin, E. V.; Piskarev, I. M.; Shevchenko, O. P. (Moscow State Univ.). Yadern. Fiz.; 20: No. 3, 433-437(Sep 1974). (In Russian).

The total photoneutron cross sections for ^{64}Zn and ^{68}Zn are obtained. The measurements were carried out from the threshold to 27 MeV in 50 keV steps. The cross sections show an obvious structure. The halfwidth of the curves is about 10 MeV. If the multiple production is not considered, then the integral cross sections for ^{64}Zn and ^{68}Zn are 800 ± 80 and 1630 ± 160 MeV · mb. The experimental data are compared with predictions of collective dynamical theory and with the concept of isospin splitting of the giant dipole resonance. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 4469, 4475, 4485, 4897, 4916, 4927, and 5031.

4933 (FRNC-TH-489) CONTRIBUTION TO STUDYING THE COMPOUND-NUCLEUS NUCLEAR REACTIONS. Dependence of ^{117}Te Formation and Deexcitation on the Energy and Angular Momentum. Guerreau, D. (Paris-11 Univ., 91 - Orsay (France)). 1973. 106p. (In French). Dep. NTIS (US Sales Only) $8.50.

Thesis.

The effect of large angular momenta on the formation and deexcitation of the ^{117}Te compound nucleus was investigated. This nucleus was formed at excitation energies of 71 and 107 MeV by using nitrogen and neon projectiles. Different angular momentum states were used in each experiment. Different targets (^{103}Rh, ^{77}Se) were chosen for the projectiles (^{14}N, ^{40}A) employed. The nearness of the 50-proton magic shell enabled the effect of closed shells on the deexcitation to be investigated. The results are interpreted in terms of a statistical model. A strong dependence of α particle emission on the spin states of the compound nucleus is demonstrated. The α particles are preferentially emitted at the beginning of the deexcitation process from the nucleus which has a high angular momentum. The growth in angular distribution anisotropy with J dies away for high-energy α particles. This phenomenon is explained by the large effect of the yrast levels on the deexcitation of high-spin levels, which restrains the α particle emission at high energy. The angular distribution of charged particles emitted in reactions induced by argon projectiles exhibits, in addition to their strong anisotropy, a complete symmetry in relation to 90 degrees—illustrates the presence of a very pure compound nucleus mechanism. The analysis of the angular distributions of the α particles emitted led to the determination of the critical angular momentum J_c above which the compound nucleus is not formed. This new method is sufficiently sensitive when the penetrativities are associated with relatively high values of l (orbital angular momentum) which at given energies do not lead to J values too close to the corresponding yrast level. It is shown that the value of J_c depends not only on the equilibrium properties of the compound nucleus, but also on the dynamic properties of the incoming channel. (FR)

4934 (GSI-tr-74/9) NEW DELAYED PROTON SOURCES ^{119}Ba, ^{121}Ba and ^{116}Cs. Bogdanov, D. D.; Demyanov, A. V.; Karnaukhov, V. A.; Petrov, L. A. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F.R. Germany)). Apr 1974. 7p. (In German). INIS.

5 figs.; 11 refs. With abstract. Translation of the Russian report JINR-P6-7716.

These delayed proton sources, ^{119}Ba (5.35 ± 0.30 sec), ^{121}Ba (29.7 ± 1.5 sec), and ^{116}Cs (3.9 ± 0.4 sec) have been produced in the heavy-ion beam by means of the mass separator BEMS-2. The proton spectra have been measured and the relative proton decay probability has been determined. (auth)

4935 (STI/DOC-10/156) HANDBOOK ON NUCLEAR ACTIVATION CROSS-SECTIONS. Technical Reports Series No. 156. (International Atomic Energy Agency, Vienna (Austria)). 1974. 567p. IAEA $26.00.

This volume contains neutron, photon, and charged-particle nuclear reaction cross section data. Separate abstracts were prepared for each of the six articles contained therein. (RWR)

For abstracts of individual papers see: 4891, 4927, and 4936–4939.

4936 (STI/DOC-10/156, pp 1-13) 2200 m/s NEUTRON ACTIVATION CROSS-SECTIONS. Sher, R. (Stanford Univ., CA). 1974.

2200 m/s neutron activation cross sections for a large number of isotopes of interest to neutron activation analysis are presented. In addition to the cross sections, values are given for the half-lives of the activities formed and the cross sections for activation of isomeric and ground states, if these are both of interest. (1 table) (auth)

4937 (STI/DOC–10/156, pp 15-86) INFINITE-DILUTION RESONANCE INTEGRALS. Albinsson, H. (Swedish Research Council's Lab., Studsvik). 1974.

A compilation is given of infinite-dilution resonance integrals (1/v contribution included). Most results were obtained from experiments, although in some cases evaluated data are also included. The resonance-integral values normalized to conform to various standards, mainly those from ^{197}Au and ^{59}Co. (1 table, 206 references) (auth)

4938 (STI/DOC–10/156, pp 87-272) TABLES AND GRAPHS OF CROSS SECTIONS FOR (n,p), (n,α), AND (n,2n) REACTIONS IN THE NEUTRON ENERGY REGION 1 TO 37 MeV. Bormann, M.; Neuert, H.; Scobel, W. (Univ., Hamburg). 1974.

The tables of recommended cross sections are intended mainly to be of practical use in activation analysis and also in nuclear chemical research or systematic nuclear physical analysis; therefore, the compilation is not extended to the reaction types (n,d), (n,γ), (n,τ), and (n,t), which are usually of minor practical interest. The literature before 1 March 1972 was considered. The recommended values were deduced from the data by preferentially using series of newer publications. The mean values are characterized by typical errors; it was not possible to calculate weighted mean values because the information given in the literature is sometimes too incomplete to be treated consistently. Occasionally, the well-known semiempirical formulas were applied. In some cases no recommendation could be given because of lack of a sufficient number of reliable measurements. The interval of the excitation functions is divided into three groups: 13.9 to 14.29 MeV, 14.3 to 14.69 MeV, and 14.7 to 15.09 MeV neutron energy. Usually one recommended value for each interval is given. Special attention should be paid to the original literature because in several cases the main sources of errors are the use of different standard values of cross sections and the incomplete knowledge of the decay scheme of the radioactive isotope considered. The compilation is restricted to excitation functions from 1 to 37 MeV that can be measured by activation techniques. For practical purposes, mainly absolute cross sections are needed; therefore, excitation functions given only in relative units were excluded. As the excitation functions given in the literature frequently differ for several reasons, less in shape but more in the absolute cross-section values, mean excitation functions were not deduced by averaging over the published data. Where there are significant differences in the absolute values, the excitation functions should be renormalized by using the 14-MeV cross-section values. (252 figures, 3 tables, 645 references) (auth)

4939 (STI/DOC–10/156, pp 475-558) PHOTONUCLEAR CROSS-SECTIONS. Buelow, B.; Forkman, B. (Univ. of Lund, Sweden). 1974.

A compilation is given of about sixty (γ,n) cross sections in the giant resonance region, which are sometimes complemented with cross sections for other types of reactions. Special reference is taken to needs in activation analysis. (145 figures, 4 tables) (auth)

4940 (n,2n) CROSS SECTIONS AND THE STATISTICAL MODEL PREDICTIONS. Kondaiah, E. (Tata Inst. of Fundamental Research, Bombay). J. Phys., A (London); 7: No. 12, 1457-1463(11 Aug 1974).

Published literature up to October 1973 has been scanned to obtain the experimental (n,2n) cross sections at E_n = 14 to 15 MeV. Weighted average of the total (n,2n) cross sections reported and the probable error in it are tabulated for each nuclide in the region A = 2 to 238. (n,2n) cross sections at E_n = 14.5 MeV have been calculated using Pearlstein's formulae (Nuclear Data A: 3; 327-41 (1967)) based on the statistical model with new constants determined by the authors, these theoretical cross sections are also tabulated for nuclides in the region A = 23 to 209. A comparison of the theoretical values and the weighted averages of the experimental values shows that (a) the statistical model values in general agree well with the experimental values; (b) the theoretical cross sections agree well with the experimental cross sections even for target nuclides having neutron shell closures except in the case of ^{39}K and ^{54}Fe, which have high (n,2n) thresholds comparable to the incident neutron energy. It is concluded that there are no shell effects other than those manifested in Q values and the level density parameters, which have been properly taken into account in these calculations. (auth)

4941 POPULATION OF EXCITED STATES IN DELAYED NEUTRON EMISSION. Crawford, G. I.; Hall, S. J.; Kellie, J. D. (Univ. of Glasgow). J. Phys., A (London); 7: No. 12, L141-L143 (11 Aug 1974).

Gamma rays have been detected in coincidence with delayed neutrons following the decay of ^{95}Rb, ^{90}Br and ^{85}As. The energies of the first excited states of ^{94}Sr and ^{89}Kr are identified as 837 keV and 424 keV, respectively. (auth)

4942 DECAY OF ^{131}Te AND ^{133}Te ISOMERS. Fujiwara, I.; Imanishi, N.; Nishi, T. (Kyoto Univ.). J. Inorg. Nucl. Chem.; 36: No. 9, 1921-1923(Sep 1974).

The absolute intensities of γ-rays of the isomers in ^{131}Te and ^{133}Te have been measured. The fractions and the internal conversion coefficients of the isomeric transitions have been determined by applying a chemical effect of the internal conversion process. Branching fractions of ^{133}Sb decay to ^{133}Te isomers were also reinvestigated. (auth)

4943 ATOMIC WEIGHTS OF THE ELEMENTS 1973. Report From the Commission on Atomic Weights of the Inorganic Chemistry Division of the International Union of Pure and Applied Chemistry. Pure Appl. Chem.; 37: No. 4, 589-603(1974).

The Commission recommends two changes in atomic weights: for nickel, 58.70 instead of 58.71; and for rhenium, 186.207 instead of 186.2. Reasons are given. Among changes in wording and content of the Atomic Weights Table is one concerning certain radioactive elements (e.g. the transplutonium elements) whose atomic weights cannot be quoted precisely without knowledge of origin: here the former practice has been revived of giving the value of the atomic mass number of the isotope of the element of longest known half life. Footnotes to the table refer to other elements (e.g. uranium) which may have variations in isotopic composition for various reasons. These matters are discussed in some detail in the report, and draft statements are put forward, for use in commerce, for labelling materials which contain elements having an isotopic composition other than "normal," in order to minimize misunderstandings and errors in the interpretation of analytical data or inadvertent use of valuable (isotopically enriched) materials for common purposes. A revised "Table of relative atomic masses of selected nuclides" is presented. (UK)

4944 NARROWING OF MOESSBAUER LINES BY SELECTIVE MODULATION. Lifetime Distribution of Excited Nuclei. Hannaford, P. (Commonwealth Scientific and Industrial Research Organization, Melbourne). J. Phys., C (London); 7: No. 17, L332-L334(7 Sep 1974).

Expressions are obtained for the distribution of lifetimes and the mean lifetime of excited Mössbauer nuclei which contribute to γ-ray emission lines detected by selective modulation. The treatment is restricted to the case of pure natural-broadened line profiles. (auth)

4945 DECAY OF ^{116g}Ag AND ^{116m}Ag. Bjoernstad, T.; Alstad, J. (Univ. of Oslo). J. Inorg. Nucl. Chem.; 36: No. 10, 2159-2166 (Oct 1974).

The decay of ^{116g}Ag and ^{116m}Ag has been investigated using enriched ^{116}Cd targets, a neutron generator producing 14-MeV neutrons and γ spectroscopy (Ge(Li) detectors). The half-lives are determined to be (2.65 ± 0.06) min and (10.5 ± 0.5) sec, respectively, for ^{116g}Ag and ^{116m}Ag. Some new γ energies are found, and a decay scheme including both nuclides is proposed. The most probable spin of ^{116g}Ag is found to be 2^-. As the isomeric transition is suggested to be E3 in the literature, the spin of ^{116m}Ag would be 5^+. This spin is not consistent with the present decay scheme. (auth)

4946 THEORY OF SINGLE PASSAGE NUCLEAR MAGNETIC RESONANCE ON ORIENTED NUCLEI WITH SMALL ELECTRIC QUADRUPOLE INTERACTIONS. Callaghan, P. T.; Johnston, P. D.; Stone, N. J. (Oxford Univ.). J. Phys., C (London); 7: No. 17, 3161-3181(7 Sep 1974).

The theory relevant to the observation of nuclear magnetic resonance of dilute impurities in solids, by the change in the gamma- and beta-ray emission distributions from oriented nuclei, is discussed for the situation where an electric quadrupole interaction produces a splitting of the nuclear magnetic resonance line comparable with the interaction energy with the applied RF field. The major deviations from conventional adiabatic fast passage expected for a single sweep of the RF frequency through the resonance condition are shown to be well reproduced by recent experimental results, indicating the validity of the theoretical model discussed. (auth)

4947 THE NUCLEI OF ATOMS AND MAGIC NUMBERS. Keller, C. Bild Wiss.; 11: No. 1, 44-51(Jan 1974). (In German). 11 figs.

The nuclei of most atoms are ellipsoidal or are shaped like cigars or discuses. Spherical nuclei are rare, but extremely stable. The so-called shell model of the nuclei can be extrapolated; this shows that beyond the transuranic elements very heavy, relatively stable nuclei can be expected. Experiments to produce them using heavy ion accelerators were begun only recently. (auth)

4948 DECAY OF RESONANT STATES IN THE REACTION ^{92}Mo(n,γ)^{93}Mo. Rudak, L. V.; Rudak, E. A. (Inst. of Physics, Minsk). Yadern. Fiz.; 20: No. 3, 483-488(Sep 1974). (In Russian).

The structure of lower levels of ^{93}Mo is studied in the intermediate coupling approximation in the framework of the generalized model. The obtained wave functions together with the data on the partial radiative widths of neutron resonances in ^{92}Mo are used to estimate the contributions from the simplest configurations to the wave functions of ^{93}Mo highly excited states. (auth)

4949 FISSION-LIKE ENVIRONMENT IN REACTIONS WITH VERY HEAVY IONS. Moretto, L. G.; Heunemann, D.; Jared, R. C.; Gatti, R. C.; Thompson, S. G. (Univ. of California, Berkeley). pp 351-364 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 2); CONF-730823-P2.

The dynamical aspects of the later stages of fission can be studied in the broader context of those reactions where the collective degrees of freedom play a dominant role. The interaction of large heavy ions with nuclei provides an ideal tool to sample the conditions prevailing in a scission-like environment. For this purpose a program was started to study the reactions between ^{40}Ar and various targets. Energetic particles produced in these reactions are observed at various angles by means of a counter telescope. The analysis of the data provides the atomic number of the emitted particles, their angular distribution, and their kinetic energy distribution. The reactions between ^{40}Ar and both a Cu and a Ag target at 288 MeV bombarding energy show an impressive emission of particles ranging in atomic number from 1 to 25 and above, matched in variety only by the fission process itself. The angular distributions are mostly peaked forward with the exception of the fragments with atomic number close to 18 in the case of the Cu target, for which a cross section increasing with angle is observed. The Z distribution at various angles suggests that the system is relaxing along the mass asymmetry coordinate. In the case of the Cu target the charge distribution seems to drift toward lower Z, while in the case of the Ag target the drift is in the direction of larger Z. This result is consistent with the potential energy of two spherical liquid drops in contact and rigidly rotating. The kinetic energy distributions are Gaussian-like and peak at energies close to the Coulomb energies of two touching spheres. Both the charge distributions and the kinetic energy distributions suggest the picture of a very viscous dynamical evolution dominated by the potential energy. This evidence is consistent with the assumption of a viscous dynamical process in the latter stages of fission. (8 figures) (auth)

Nuclear Properties and Reactions, $150 \leq A \leq 189$

Refer also to abstracts 3463, 4459, 4927, 4931, 4936–4940, and 5017.

4950 (BUP-65) REDUCED TRANSITION PROBABILITIES IN ^{162}Dy, ^{232}Th, AND ^{238}U. Thorsteinsen, T. F.; Videbaek, F. (Bergen Univ. (Norway). Dept. of Physics). Apr 1974. 24p. Dep. NTIS (US Sales Only) $4.25.

In previous work on inelastic scattering with 12-MeV deuterons from deformed nuclei, proportionality was assumed between the differential cross sections and the reduced transition probabilities. The normalization was made on transition probabilities measured by Coulomb excitation with α-particles. The results of these measurements on ^{162}Dy, ^{232}Th and ^{238}U are reported. The angular distributions of 12-MeV deuterons inelastically scattered from deformed nuclei are smooth and without diffraction structure so that measurements of the inelastic cross sections at only two angles will in general be sufficient to determine the multipolarities of the transitions. In Coulomb excitation the excitation functions are characteristic of the different multipolarities. Measurements of inelastic cross sections at two different bombarding energies should therefore be reliable as the "two-point angular distributions". Such measurements were therefore carried out at 90 and 125° with 12- and 13-MeV deuterons on ^{232}Th and ^{238}U. Few measurements of the octupole vibrational strength in the actinide region have previously been available. Such measurements are important as a validity check of the present theoretical description of those vibrations. (auth)

4951 SINGLE-PARTICLE TRANSFER STUDIES OF ODD-ODD DEFORMED NUCLEI AND THE RESIDUAL NEUTRON-PROTON INTERACTION. Elmore, D. Rochester, NY; Univ. of Rochester (1974). 268p. University Microfilms Order No. 74-22,574.

Thesis (Ph. D.).

The level structure of the odd–odd nuclei ^{156}Tb, ^{158}Tb, ^{172}Lu, and ^{184}Re was investigated by means of the (^{3}He,d) and (α,t) reactions, and ^{184}Re was also investigated by means of the (d,t) and (^{3}He,α) reactions. The spectra are interpreted in terms of two-quasiparticle states formed by the coupling of the transferred particle and the odd particle in the target ground state, each in separate Nilsson orbitals. Identification of rotational bands is based on a comparison of the measured cross section patterns and energy spacings with those predicted with the aid of Coriolis mixing and DWBA calculations. Assignments are proposed, some tentatively, for the bands arising from both the parallel and antiparallel coupling of the following orbitals: in ^{156}Tb and ^{158}Tb, the $3/2^-$[521] neutron with the $3/2^+$[411] proton; in ^{158}Tb, the $3/2^-$[521] neutron with the $5/2^-$[532], $7/2^+$[404], $5/2^+$[402] proton; in ^{172}Lu, the $1/2^-$[521] neutron with the $7/2^+$[404], $1/2^-$[541], $5/2^+$[402], $9/2^-$[514] proton; and in ^{184}Re, the $1/2^-$[510], $3/2^-$[512], $7/2^-$[503], $11/2^+$[615] neutron with the $5/2^+$[402] proton. This results in twelve new splitting energies due to the residual neutron-proton interaction and two new odd–even shifts for K = 0 bands. Theoretical calculations are made for the 68 energy splittings presently known, using a central two-body interaction with both a zero-range and a Gaussian radial dependence. For the best choice of potentials, most of the splittings are well described by the calculations, however the form of the interaction is not well specified by a fit to experiment. (Diss. Abstr. Int., B)

4952 HIGH–SPIN STATES IN ^{167}Lu. Foin, C.; Barnéoud, D. (Institut des Sciences Nucléaires, Centre de Tri, 38044 Grenoble–Cedex, France). Phys. Rev. Lett. 33: No. 17, 1049-1051 (21 Oct 1974).

We have studied the properties of two rotational bands in ^{167}Lu for high spin values. Backbending is observed in the $^{7/2+}$[404] band, but not in the $^{1/2+}$[541] band. These results are in agreement with the rotation–alignment model. (auth)

4953 OBSERVATION OF MULTISTEP INELASTIC PROCESSES IN HEAVY–ION–INDUCED TWO–NEUTRON TRANSFER REACTIONS ON RARE–EARTH NUCLEI. Erb, K. A.; Hanson, D. L.; Ascuitto, R. J.; Sórensen, B.; Vaagen, J. S. (Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06520); Kolata, J. J. Phys. Rev. Lett. 33: No. 18, 1102-1105 (28 Oct 1974).

Strong experimental evidence for the importance of multistep processes has been obtained from the reaction ^{186}W(^{12}C, ^{14}C)^{184}W at 70 MeV. The angular distributions are in good agreement with theoretical predictions and show dramatic influence from inelastic nuclear–Coulomb interference as well as from direct, two–step interference. (auth)

4954 THE CONVERSION ELECTRON SPECTRUM OF THE REACTION ^{155}Gd(n,e)^{156}Gd. Schreckenbach, K. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Department). Z. Naturforsch., a; 29: Nò. 1, 17-30(Jan 1974). (In German).

3 figs.; 7 tabs.; 25 refs.

The conversion electron spectrum of the reaction ^{155}Gd(n,e)^{156}Gd has been measured up to 8.5 MeV. The results below 4.5 MeV are presented and multipolarities are determined with these results. E0 admixtures of the ΔI = 0 transitions from the 0^+ β-vibrational band to the ground state band were determined with 15% accuracy. ^{156}Gd level schemes are discussed and extended by new spin and parity assignments. (auth)

4955 GAMMA RAYS FROM 11.8 MIN ^{165}Lu, A NEW ISOTOPE. Meijer, B. J.; De Boer, F. W. N.; Goudsmit, P. F. A. (Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands)). Radiochim. Acta; 19: No. 3, 150(1973).

1 tab.; 11 refs.

In our study of neutron deficient lutetium isotopes we have observed a new 11.8 minute activity in sources produced by irradiating thulium foils with ^{3}He ions. We ascribe it to ^{165}Lu. (orig.)

4956 PARTICLE NUMBER DEPENDENCE OF COLLECTIVE PROPERTIES OF NUCLEI IN THE RARE EARTH REGION. Rafelski, H.; Fink, B. (Frankfurt Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Naturforsch., a; 29: No. 8, 1131-1137(Aug 1974).

7 figs.; 11 refs.

Within the framework of the pairing plus quadrupole interaction model and by using the technique of quasi spin formalism it is possible to determine the collective potential and kinetic energy surfaces as analytic functions of the particle number in the limit that single particle splittings are neglected. Pushing the quasi spin model in an extended version up to the 4th order in perturbation theory the stiffness and mass parameters of harmonic and anharmonic terms for Dy, Er, Yb, and Hf-isotopes have been calculated. The theoretical particle dependence of collective quantities shows a good qualitative and even quantitative agreement with experimental data and former calculations. (auth)

4957 ANGULAR MOMENTUM DEPENDENCE OF THE FISSION PROBABILITY OF ^{170}Yb COMPOUND NUCLEI AT AN EXCITATION OF 107 MeV. Zebelman, A. M.; Beg, K.; Eyal, Y.; Jaffe, G.; Logan, D.; Miller, J.; Kandil, A.; Kowalski, L. (Columbia Univ., New York). pp 335-350 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 2); CONF-730823-P2.

Fission and complete-fusion cross sections are presented for four entrance channels leading to ^{170}Yb compound nuclei excited to 107 MeV: ^{11}B + ^{159}Tb, ^{12}C + ^{158}Gd, ^{16}O + ^{154}Sm, and ^{20}Ne + ^{150}Nd. The measured fission cross sections are 5.9 ± 0.6 mb, 16.0 ± 2.0 mb, 40.0 ± 4.0 mb, and 89.0 ± 9.0 mb for the ^{11}B, ^{12}C, ^{16}O, and ^{20}Ne entrance channels, respectively. The complete-fusion cross sections for these same entrance channels are 980.0 ± 150 mb, 1100 ± 160.0 mb, 1260.0 ± 190.0 mb, and 1450.0 ± 220.0 mb. The data are combined by using a technique which yields the dependence of fission probability over three relatively narrow ranges of angular momentum. The results of the analysis are compared with a theoretical calculation based on the Bohr–Wheeler formalism for fission widths and the Weisskopf formalism for neutron and charged-particle widths. The calculations include the effects of multiple chance fission but assume that second- and higher-chance fission is nonnegligible only if preceded by s-wave neutron emission rather than charged-particle emission. Good agreement between the experimental results and the theoretical calculations is found for a ratio of level density parameters for the saddle point and the compound nucleus equal to 1.2 ± 0.1. (7 figures, 4 tables) (auth)

4958 COUPLED CHANNELS REACTION AND FORM FACTOR EFFECTS IN DIRECT REACTIONS ON STRONGLY DEFORMED NUCLEI. Broad, A. S. Ann Arbor, MI; Univ. of Michigan (1974). 223p. University Microfilms Order No. 74-25,158.

Thesis (Ph. D.).

The reaction ^{162}Dy (^{3}He,d)^{163}Ho was studied at 46.47 MeV. Angular distributions from 0° to 30° were taken with resolutions of 15 to 25 keV (fwhm). The elastic and inelastic scattering experiments ^{165}Ho (d,d) at 29 MeV, ^{166}Er (d,d) at 34.5 MeV, and ^{162}Dy (^{3}He, ^{3}He) at 46.47 MeV were performed in order to verify optical-model parameters. Coupled-channels reaction and form-factor calculations were performed along with the standard DWBA computations. The CCBA (coupled-channels Born-approximation) calculations accounted for the inelastic excitation of the low-lying rotational states. The CC form factors were solutions of the Nilsson Hamiltonian but are not truncated in the radial quantum number, n, as is usually done. It is shown that both the CC form factors and reaction calculations can have large effects in the analysis of proton orbitals in ^{163}Ho. It is also demonstrated that, in many cases, there exist large discrepancies between the theoretical calculations and the data. Two neutron orbitals in ^{237}U were also analyzed by using the coupled-channels form factors. It is again demonstrated that this calculation can have large effects in extracting nuclear structure information. The experimental elastic scattering distributions cannot be reproduced by using standard optical parameters in a spherical-optical-model calculation. However, it is demonstrated that in a coupled-channels calculation the same parameters give excellent fits. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, $190 \leq A \leq 219$

Refer also to abstracts 4459, 4469, 4897, 4919, 4927, 4936–4938, 4940, 5003, and 5030.

4959 (AD-780966) NUCLEAR STRUCTURE STUDIES USING THE RESONANCE FLUORESCENCE TECHNIQUE. Final Report, 8 May 1969–7 May 1974. Swann, C. P. (Bartol Research Foundation, Swarthmore, Pa. (USA)). 12 Jun 1974. 16p. (AROD-8317.8-P). NTIS $3.00.

This is the final report of work done under these grants. The resonance fluorescence technique was used in these studies with the source of radiation being either gamma rays from the ^{19}F(p,$\alpha\gamma$)^{16}O reaction or from electron Bremsstrahlung. Properties of levels at about 7 MeV in ^{16}O, ^{23}Na, ^{207,208}Pb and ^{209}Bi and from 1 to 5 MeV in ^{59}Co, ^{24}Mg, ^{206,207,208}Pb, ^{209}Bi and ^{63,65}Cu were deduced from these measurements. Seven papers have been or are to be published and two additional ones are being prepared. (GRA)

4960 TWO–NUCLEON INTERACTION IN NUCLEI NEAR THE DOUBLY MAGIC NUCLEUS Z=82, N=126. Kusch, W. (Nuclear Physics Institute, Warsaw). Sov. J. Part. Nucl. 5: No. 2, 133-151 (Oct 1974).

The problem of nucleon–nucleon interaction in nuclei near ^{208}Pb is analyzed on the basis of the structure of their excited levels. Experimental data are presented on the excited states of these nuclei, the theoretical papers dealing with the application of phenomenological potentials for the description of the nuclei are reviewed, and the results of investigations in which the free–nucleon potentials serve as the starting point are also considered. (auth)

4961 STUDY OF STRONGLY DAMPED COLLISIONS IN THE REACTION OF 600-MeV ^{84}Kr ON A ^{209}Bi TARGET. Wolf, K.L.; Unik, J.P. (Argonne National Laboratory, Argonne, Illinois 60439); Huizenga, J.R.; Birkelund, J.; Freiesleben, H.; Viola, V.E. Phys. Rev. Lett. 33: No. 18, 1105-1108 (28 Oct 1974).

Detailed information on a new reaction mechanism is presented for a 600–MeV ^{84}Kr bombardment of ^{209}Bi. This reaction process represents a major fraction of the total–reaction cross section and is characterized by strong damping of energy degrees of freedom, but on the average, a relatively small amount of mass exchange compared to fission. (auth)

4962 ENERGY AND MASS DISTRIBUTIONS OF FRAGMENTS FROM FISSION OF ^{209}Bi, ^{197}Au, ^{nat}W, AND ^{nat}Yb BY 1-GeV PROTONS. Kotov, A. A.; Semenchuk, G. G.; Andronenko, L. N.; Andronenko, M. N.; Gorshkov, B. L.; Kovshevnyi, G. G.; Reznik, V. R.; Solyakin, G. E. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 20: No. 3, 467-471(Sep 1974). (In Russian).

The energy and mass distributions of fragments from fission of the nuclei ^{209}Bi, ^{197}Au, ^{nat}W and ^{nat}Yb by 1-GeV protons were measured by means of the semiconductor detectors in the extracted beam of the LINP synchrocyclotron. The increase of the widths of mass distribution and the stability of the widths of energy distributions when the parameter Z^2/A decreases is related with the approach to the Businaro–Gallone instability point. (auth)

4963 FISSION OF ^{238}U, ^{209}Bi, AND ^{197}Au WITH INTERMEDIATE-ENERGY ^{4}He IONS. Viola, V. E. Jr.; Minor, M. M.; Roche, C. T.; Clark, R. G. (Univ. of Maryland, College Park). Contract AT(40-1)-4028. pp 391-408 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 1); CONF-730823-P1.

The fission of ^{238}U, ^{209}Bi, and ^{197}Au induced by 140- and 150-MeV ^{4}He ions was studied in order to investigate the dependence of the effective moment of inertia at the fission saddle point on excitation energy. Particular emphasis was placed on the investigation of the reaction mechanism which produces the fissioning species in these systems. From fission fragment angular correlation measurements it was found that 49.3 ± 4.4% of the fission in ^{238}U results from the formation of a compound nucleus. The noncompound-nucleus component of the fission cross section includes a large fraction of high linear momentum transfer events, presumably produced in reactions where pre-equilibrium decay is highly probable. The fission of ^{197}Au and ^{209}Bi with 140-MeV ^{4}He ions was found to proceed almost completely via a compound-nucleus mechanism. Examination of the forward–backward symmetry of the angular distributions measured in this work substantiates the angular correlation results. From the anisotropy in the angular distributions, values for $\mathscr{I}_{eff}/h^2a_f$ were determined. These calculations included corrections for the effects of noncompound-nucleus mechanisms on the orbital angular momentum distribution of the fissioning nuclei and for neutron evaporation prior to fission. Contrary to earlier work, it was found that $\mathscr{I}_{eff}/h^2a_f$ is constant within the uncertainties of the calculation. (9 figures, 3 tables) (auth)

Nuclear Properties and Reactions, $A \geq 220$

Refer also to abstracts 3494, 4869, 4883, 4927, 4936–4940, 4950, 4958, 4963, and 5029.

4964 (BNL–18926) LOW SPIN STATES IN ^{202}Hg. Breitig, D.; Casten, R. F.; Kane, W. R.; Cole, G. W.; Cizewski, J. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 5p. (CONF-740920–14). Dep. NTIS $4.00.

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

States in ^{202}Hg were studied with several techniques involving the (n,γ) reaction at thermal and resonant neutron energies. Gamma ray spectra were recorded for primary and secondary transitions and in singles and coincidence modes. A level scheme comprised of 22 excited states and ~80 transitions was constructed. Comparison of these results with analogous results for ^{200}Hg reveals important nuclear structure differences. (auth)

4965 (CONF-740903-10) ESTIMATED DATA COVARIANCE FILES OF EVALUATED CROSS SECTIONS: EXAMPLES FOR ^{235}U AND ^{238}U. Perey, F. G.; de Saussure, G.; Perez, R. B. (Oak Ridge National Lab., Tenn. (USA)). 1974. 14p. Dep. NTIS $4.00.

From meeting on advanced reactors; physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

The status of development of formats and methods to represent uncertainty information of evaluated microscopic data in the ENDF/B system is reviewed. Some examples of methods to obtain the data covariances of important cross sections for fertile and fissile nuclides are given. Some examples are given of typical group cross sections covariance matrices obtained by processing the ENDF/B estimated data covariance files. (auth)

4966 (CSNSM-T-74-01) EXPERIMENTAL AND THEORETICAL STUDIES OF 193 AND 195 GOLD ISOTOPES. Vieu, C. L. M. (Centre National de la Recherche Scientifique, 91-Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse). Jan 1974. 113p. (In French). Dep. NTIS (US Sales Only) $8.75.

Thesis. Submitted to Univ. of Paris, Orsay, France.

The electromagnetic transitions, emitted by strong isotopically pure 193 and 195 mercury samples, were studied with Ge(Li), Si(Li) detectors, a double focusing $\pi\sqrt{2}$ magnetic spectrometer and a Gerholm spectrometer. These direct β and γ spectrometry studies were completed with γ-γ multidimensional measurements. In gold 193 and 195, forty-five and four new levels were found respectively. All the levels of these nuclei received spin and parity assignments from the multipolarities of their deexciting transitions and the log ft values. Their level schemes have many analogies: twenty-two levels in gold 193 were also identified in gold 195. In these two nuclei, the energy levels and the reduced transitions probabilities were compared to the theoretical values calculated according to the one quasi particle model with quadrupole-quadrupole interaction. The interpretations, given to twenty-five levels in gold 193 and sixteen levels in gold 195, generally account for the experimental data. However, strong discrepancies exist between the experimental and theoretical energies of several levels. The theoretical predictions of the Alaga model have shown that these discrepancies result from the influence of the broken pairs, neglected in the one quasi particle model. (auth)

4967 (STI/PUB-347 (Vol. 2)) PHYSICS AND CHEMISTRY OF FISSION, 1973. Volume II. Proceedings Series. Proceedings of the Third IAEA Symposium Held in Rochester, New York, August 13-17, 1973. (International Atomic Energy Agency, Vienna (Austria)). May 1974. 533p. (In French and English). (CONF-730823-(P2)). IAEA $24.00.

Separate abstracts were prepared for 18 of the papers in this volume. The remaining nine have already appeared in NSA with the following abstract numbers: 28: 14174, 28: 19979, 28: 20005, 28: 22874, 28: 22923, 28: 23022, 28: 23023, 28: 23083, and 29: 14232. (RWR)

For abstracts of individual papers see: 3494, 4949, 4957, 4985–4998, and 5029.

4968 (UCRL-51640) TABLES OF VALUES OF Z_p, THE MOST PROBABLE CHARGE IN FISSION. Nethaway, D. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Jul 1974. 47p. Dep. NTIS $4.00.

This report is a compilation of values of Z_p, the most probable charge in fission, that have been calculated for neutron-induced and spontaneous fission of many of the heavy elements. The calculation of Z_p is based on a recent method which utilizes the $Z_p(A)$ function for thermal-neutron fission of uranium-235 as a reference. Corrections to the reference Z_p function for other fissioning systems are calculated by using an equation with coefficients obtained by a least-squares analysis of all of the measured fractional chain yield data. A table of calculated independent and cumulative fractional chain yields versus $Z - Z_p$ is also included so that estimates of fractional chain yields can be made from the tabulated Z_p values. (37 tables) (auth)

4969 AVERAGE YIELD OF PROMPT NEUTRONS $\bar{\nu}$ IN THE FISSION OF ^{233}U BY NEUTRONS WITH ENERGIES FROM 0 TO 1.4 MeV. Nurpeisov, B.; Nesterov, V. G.; Prokhorova, L. I.; Smirenkin, G. N. Sov. At. Energy (Engl. Transl.); 34: No. 6, 603-604(Jun 1973).

Translated from At. Energ. (USSR); 34: No. 6, 491-493(Jun 1973).

The method of relative measurements was used with neutrons from the T(p,n) reaction. The value for ^{252}Cf was taken as standard. The ratio $\rho/\rho_0 = A\bar{\nu}/\bar{\nu}_0$ was measured directly, where ρ and ρ_0, respectively, are the number of true coincidences and the number of fissions for the isotope under study and the standard, and $A \approx 1$ is a factor taking account of the difference in detector efficiencies in measurements with a layer of ^{252}Cf and an arrangement of layers of ^{233}U. Recommended values over the energy range are tabulated. (1 figure, 2 tables). (RWR)

4970 INVESTIGATION OF PHOTONUCLEAR REACTIONS LEADING TO SPONTANEOUSLY FISSIONING ISOMERS. Gangrskii, Yu. P. (Joint Inst. for Nuclear Research, Dubna, USSR); Markov, B. N.; Tsypenyuk, Yu. M. Fortschr. Phys.; 22: No. 4, 199-224(1974).

The excitation functions of the (γ,n) and (γ,γ') reactions leading to the formation of the ^{239}Pu, ^{241}Pu, ^{240}Am, ^{242}Am, and ^{243}Am spontaneously fissioning isomers were measured. The experiments were carried out using a 17-orbit microtron. A spark counter with pulsed feeding served as a fission fragment detector. From the excitation functions measured, the parameters of a two-humped fission barrier were obtained and compared with other experimental results and theoretical calculations. (13 figures, 3 tables). (auth)

4971 COUPLING BETWEEN QUADRUPOLE AND HEXADECAPOLE DEGREES OF FREEDOM. Dudek, W. (Univ., Warsaw). Acta Phys. Pol.; 5B: No. 5, 725-729(1974).

The energies of the quadrupole and hexadecapole vibrational states for some nuclei are calculated in the actinide region. The influence of the coupling between quadrupole and hexadecapole modes on the vibrational energies is studied. (auth)

4972 NUCLEAR CHARGE DISTRIBUTION IN MASS CHAINS 131 TO 134 IN THERMAL NEUTRON FISSION OF ^{235}U. Parsons, R. W.; Sharma, H. D. (Univ. of Waterloo, Ont.). J. Inorg. Nucl. Chem.; 36: No. 10, 2392-2396(Oct 1974).

The fractional independent yield, FIY, of mass chains 131 to 135 have been reported by several workers, but the accuracy of some of the earlier data has been questioned. The present paper reports the values of FIY of $^{131-133}$Te, ^{133}I and ^{134}I determined by following a method described elsewhere (Parsons et al., Radiochem. Radioanal. Lett.; 15: 335 (1973)). (UK)

4973 FISSION YIELD OF MOLYBDENUM-99 IN THE THERMAL NEUTRON FISSION OF PLUTONIUM-239. Jain, H. C.; Ramaniah, M. V. (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.). Radiochim. Acta; 19: No. 2, 90-93(1973).

1 tab.; 22 refs.

Detailed investigation and measurement of the fission yield of ^{99}Mo in the thermal neutron fission of ^{239}Pu was done. The disintegration rate of ^{99}Mo was determined using the recently published methods. The number of fissions was calculated by irradiating isotopically analyzed and known amounts of ^{239}Pu and ^{235}U and monitoring the neutron flux using the ^{59}Co(n,γ)^{60}Co reaction. The results show that the ^{99}Mo yield in the thermal neutron fission of ^{239}Pu is 6.82%. (auth)

4974 ANGULAR DISTRIBUTIONS OF HEAVY IONS IN DEEP INELASTIC TRANSFER REACTION. Aleshin, V. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 3, 497-503(Sep 1974). (In Russian).

Angular distributions of products are investigated in deep-inelastic transfer reactions with heavy ions. A two-component parametrization is proposed for the phase shift as function of l. Analysis of the angular distributions for the transfer reactions, proceeding at bombardment of ^{232}Th by ions of ^{22}Ne with energy of 174 MeV, shows that the pick-up of one or two protons is accompanied by a much deeper penetration of the colliding nuclei than the stripping of the same number of protons. (auth)

4975 EXPERIMENTAL SEARCH FOR SPONTANEOUSLY FISSIONABLE NUCLEI OF SUPERHEAVY ELEMENTS. Flerov, G. N.; Ter-Akop'yan, G. M.; Skobelev, N. K.; Popeko, A. G.; Ivanov, M. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 3, 472-482(Sep 1974). (In Russian).

Various methods used to search for superheavy elements in nature are analyzed. There are described large proportional counters of fragments and neutron detectors of multiple emission of neutrons which were used for searches based on registration of rare events of spontaneous fission in samples. The upper limits are determined for the content of superheavy elements in the samples of hydrooxides of bismuth ($2.5 \cdot 10^{-13}$ g/g), lead ($4 \cdot 10^{-15} - 5 \cdot 10^{-16}$ g/g), mercury ($1.4 \cdot 10^{-14} - 1.4 \cdot 10^{-15}$ g/g) and tungsten ($1.4 \cdot 10^{-14} - 2.5 \cdot 10^{-15}$ g/g) provided the half-life of the element under search be 10^9 years. (auth)

4976 NEUTRON-INDUCED TERNARY FISSION OF ^{239}Pu AND ^{242m}Am. Vorob'ev, A. A.; Grachev, V. T.; Kondurov, I. A.; Miroshnichenko, Yu. A.; Nikitin, A. M.; Seliverstov, D. M.; Smirnov, N. N. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 20: No. 3, 461-466(Sep 1974). (In Russian).

Energy spectra and yields of the light nuclei with $Z \leq 8$ produced in neutron-induced fission of ^{239}Pu and ^{242m}Am were determined using magnetic mass-spectrometer with energy, time-of-flight and $\Delta E/\Delta x$ measurements. An attempt was made to detect fragments in the mass number range 20 to 60. The upper limits for the yields of the nuclei in this mass number range were determined. The comparison of the obtained yields of the fragments in this mass number range with data of other authors is being carried out. (auth)

4977 STRUCTURE OF THE FISSION TRANSITION NUCLEUS ^{227}Ra. Groening, H.; Loveland, W. (Oregon State Univ., Corvallis). pp 39-53 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 1); CONF-730823-P1.

From experimental data for the ^{226}Ra(n,f) reaction, the height of the fission barrier and the character of the low-lying single-particle level scheme for the fission transition nucleus ^{227}Ra were deduced. The analysis involved simultaneously fitting the energy variation of the fission cross section and angular distributions in the neutron energy range $3.6 \leq E_n \leq 9.0$ MeV by using a Hauser–Feshbach formalism. The free parameters determined in fitting the data were the number, position, and (K,π) of the low-lying single-particle states at the fission barrier and the density and K_0^2 value of the higher-lying states. Neutron emission widths for the calculation were taken from experimental data. Fission widths were calculated by assuming, as suggested by theoretical calculations, a single-humped shape for the fission barrier and a Hill–Wheeler barrier penetrability expression. The best fit to the experimental data gave a fission barrier height of 3.7 MeV (relative to the neutron binding energy) and a single-particle state sequence at the barrier of $3/2^-$, $1/2^+$, $5/2^\pm$, $1/2^\pm$ for the odd-A transition nucleus ^{227}Ra. The level densities at higher energies were characterized by K_0^2 values of 8 to 10 for $4 \leq E_n \leq 7$ MeV and a_f values that increased with decreasing excitation energy. Evidence for a value of the gap parameter, $2\Delta_f$, of 2.7 MeV for the ^{227}Ra transition nucleus is presented. Comparison with theoretical predictions is made. (7 figures, 2 tables) (auth)

4978 SUBBARRIER PHOTOFISSION OF ^{238}U. Alm, A.; Kivikas, T.; Lindgren, L. J. (Univ. of Lund, Sweden). pp 55-70 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.1); CONF-730823-P1.

Experimental yield curves for symmetric and asymmetric photofission of ^{238}U in the subbarrier energy region are analyzed in the framework of a double-hump fission model, where the potential energy is described by three parabolas. In the model the outer fission barrier is assumed to depend on the type of deformation of the nucleus; this dependence leads to a coupling between symmetric and asymmetric fission. It is shown that the model reproduces well the experimental data in an energy region where the fission cross section varies by 5 orders of magnitude. The asymmetric yield can be described by one dominant 1^-, 0 channel with a resonance at 4.6 MeV and one 2^+, 0 channel. The information about the symmetric fission is, however, very limited, except that a strong resonance at about 5.8 MeV is clearly observed. The maximum at 6 MeV in the valley-to-peak ratio is interpreted as an effect of this resonance in the symmetric yield and not as an effect of neutron competition. (7 figures, 1 table) (auth)

4979 STUDY OF THE ^{231}Pa(n,f) REACTION INDUCED BY FAST NEUTRONS. Sicre, A.; Barreau, G.; Chastel, R.; Doan, T. P.; Leroux, B.; Sageaux, J. C. (Univ., Bordeaux). pp 71-83 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974). (In French).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.1); CONF-730823-P1.

The excitation function for the ^{231}Pa(n,f) reaction was measured from 100 keV to 1.3 MeV with an energy resolution of 10 to 15 keV. The neutrons were produced by the ^{7}Li(p,n) reaction, and the fission fragments were detected in 2π geometry by polycarbonate resin detectors. The cross sections were calibrated by comparison with ^{235}U(n,f) and ^{238}(n,f) cross sections. The excitation function shows two resolved resonance structures around 200 keV and 330 keV, and other structures at higher energy. Fission barrier parameters are obtained from the analysis of this excitation function with a statistical model which takes into account the competition between the different decay channels and assumes a complete damping in the two wells. Fission fragment angular distributions were measured in the vicinity of the resonances and structures. It was not possible to interpret the 200-keV and 330-keV resonances as pure vibrational resonances by using a statistical model including resonance penetration through the double humped barrier. (7 figures) (auth)

4980 HARTREE–FOCK CALCULATIONS OF THE FISSION BARRIERS OF PLUTONIUM ISOTOPES. Flocard, H. (CNRS, Orsay, France); Quentin, P.; Vautherin, D.; Kerman, A. K. pp 221-230 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 1); CONF-730823-P1.

Complete self-consistent calculations with a constraint on the quadrupole moment were performed to obtain the deformation energy curve of ^{240}Pu beyond the second barrier. Preliminary calculations of the excitation energy of the isomeric state and the first barrier height of ^{238}Pu and ^{244}Pu are also presented. These calculations were done by using a phenomenological effective interaction introduced by Skyrme and used extensively in Hartree–Fock calculations by Vautherin and Brink. This force was supplemented with the standard pairing interaction. Within the framework of this parametrization of the effective force, an improved set of parameters was determined which gives total nuclear binding energies within an accuracy of less than 8 MeV for the whole chart of nuclides and reproduces within ±3% the quadrupole moments of permanently deformed nuclei. The solution of the Hartree–Fock equations is obtained by expanding the Hartree–Fock states into deformed harmonic oscillator eigenstates. A deformation-dependent prescription for the truncation of the oscillator basis is used. Particular attention was paid to insure the independence of the results with respect to basis parameters. However, for very large deformations, such as those occurring near the second fission barrier of heavy nuclei like ^{240}Pu, the basis used here (which would correspond in the spherical case to 13 major shells) appears to be nearly sufficient. Owing to the complexity of numerical calculations, axial symmetry and left-right reflection symmetry were assumed. Two different prescriptions were used to introduce pairing correlations. The first consists in keeping a gap constant as a function of deformation for both protons and neutrons. The second introduces a pairing force proportional to the surface. For the height of the first barrier, E_A, as well as for the excitation energy, E_I, of the isomeric states, a reasonable agreement with experiment ($E_A \simeq 9.0$ MeV, $E_I \simeq 3.0$ MeV in ^{240}Pu) is obtained. However, this is no longer the case for the second fission barrier ($E_B \simeq 13.0$ MeV in ^{240}Pu). This lack of agreement may be due to the force, but there are also errors due to the imposed symmetries and to the lack of numerical convergence at large deformations. (3 figures, 3 tables) (auth)

4981 FRAGMENT ANISOTROPY IN ISOMERIC FISSION. Specht, H. J.; Konecny, E.; Weber, J.; Kozhuharov, C. (Univ., Munich). pp 285-296 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 1); CONF-730823-P1.

Measurements of fragment angular distributions in fission from isomeric states—aligned by preceding nuclear reactions—can in principle provide information about the quantum numbers of the isomeric state if independent information is known about the magnetic substate distribution and the perturbations due to extranuclear fields. Using $(\alpha,2n)$ reactions on targets of ^{235}U, ^{236}U, and ^{239}Pu with metallic Pb stoppers for the recoiling atoms (to preserve the alignment), fragment angular distributions at 90°, 125°, and 167° were measured. The delayed fragments were detected with Si detectors in coincidence with the pulsed α-beam from the Munich Tandem Accelerator. Anisotropies W(167°)/W(90°) of 0.58 ± 0.16, 1.41 ± 0.14, 0.69 ± 0.09, and 2.0 ± 0.4 were obtained for the 45-ns and 1.1-μs isomeric states of ^{237}Pu and the 6-ns ^{238}Pu and 10-ns ^{241}Cm isomers, respectively. Spin assignments for the four states are suggested on the basis of a simple Gaussian distribution for the magnetic substates, with the assumption that any perturbations are negligible. (6 figures, 1 table) (auth)

4982 DELAYED FISSION FRAGMENT ANGULAR DISTRIBUTIONS IN SOME ALPHA-PARTICLE-INDUCED REACTIONS.

Galeriu, D. (Inst. for Atomic Physics, Bucharest); Marinescu, M.; Poenaru, D.; Vilcov, I.; Vilcov, N.; Gangrsky, Yu. P.; Hien, P. Z.; Khan, N. C. pp 297-304 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 1); CONF-730823-P1.

This paper describes the measurement of the angular distribution of the fission fragments emitted by fission isomers, populated in alpha-particle-induced reactions. Such experimental data give valuable information concerning the fission isomer spin values (there has been little data on the spin values of the fissioning isomeric states up to now). Owing to the very small yield of the fission fragments, only the "integral" anisotropy factor (a = W(180°)/W(90°)) could be measured, the angular resolution being dependent on the solid angle subtended by the detectors, as well as on the fission isomer lifetime. Solid state track detectors were used to detect the fission fragments emitted by recoiling nuclei in flight. The experimental arrangement consists of three systems of detectors: a mica annular detector looking downstream with respect to the ingoing alpha-particle beam (the 180° detector), several lead glass (to lower the overall background) plain detectors oriented parallel to the beam (the 90° detectors) and a mica detector facing the target, used for monitoring purposes (the prompt fission detector). Delayed fission fragment anisotropy factors for fission isomers, populated in (α,2n) reactions on ^{235}U, ^{238}U, ^{239}Pu and ^{241}Am targets as well as in (α,3n) reactions on ^{235}U and ^{242}Pu targets, were measured. Anisotropy factors essentially differing from unity were obtained in some of the measured fission isomers, particularly in the case of ^{236mf}Pu($T_{1/2}^{mf}$ = 30 ns), assumed to represent an excited state in the second potential well. An estimate of the spin values of the fission isomers was made by using a statistical model approach. The limitations of the above method, including the precision of measuring the experimental anisotropy factors as well as the possible perturbation of the angular distributions due to the extranuclear fields, are analyzed. (3 figures, 3 tables) (auth)

4983 SPONTANEOUS-FISSION DECAY CONSTANT OF ^{235}U. Gruetter, A. (Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland); von Gunten, H. R.; Herrnberger, V.; Hahn, B.; Moser, U.; Reist, H. W.; Sletten, G. pp 305-316 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.1); CONF-730823-P1.

The partial spontaneous fission half-lives of odd-A and odd–odd actinides are observed to be orders of magnitude longer than for even–even nuclides with the same fissility parameters. For ^{233}U and ^{235}U, however, this difference in half-life is reported to be much smaller than for other even–odd actinides. This deviation from systematics could be due to inaccuracies in the measurements or to special features of the fissioning systems. An attempt was made to remeasure the spontaneous fission decay constant for ^{235}U by using the spinner detector technique. The principle of this detector is based upon producing negative pressure by centrifugal forces in a liquid containing the fissionable material. The metastable state created in this way in the solution can be destroyed as in normal bubble chambers. Very low background and a 100% efficiency even for gram quantities of fissionable material are the main features of this fission counter. About 7 g of uranium with an isotopic composition of 99.7% ^{235}U were dissolved in ethyl alcohol. Since (α,n) reactions in the alcohol influence the fission rate, spinner vessels with different diameters were used to enhance the escape probability for neutrons. In chambers of 8-cm and 4-cm diameter, count rates of (2.43 ± 0.05)/h and (0.98 ± 0.03)/h, respectively, were obtained. These count rates are compared with those predicted by neutron transport calculations for the contribution of the (α,nf) reaction. Since the spinner was operated 15 m below rock, the contribution by cosmic interactions is estimated to be negligible. After correction for the contribution of the spontaneous fission of ^{238}U, a conservative upper limit for the decay constant of ^{235}U of 3.9×10^{-19} yr^{-1} was obtained. This limit is at least five times lower than the values published by others. Therefore, it is concluded that the deviation in fission hindrance of ^{235}U compared with other even–odd actinides was at least partly due to an inaccuracy in the measurements. (3 figures, 7 tables) (auth)

4984 HALF-LIFE SYSTEMATICS OF FISSION ISOMERS IN EVEN–EVEN Pu ISOTOPES. Metag, V.; Liukkonen, E.; Glomset, O.; Bergman, A. (Univ. of Copenhagen). pp 317-325 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 1); CONF-730823-P1.

An improved recoil-distance method allows the detection of fission isomers with half-lives in the ps to ns region. This improvement is achieved by shortening the distance which the recoil nucleus is required to fly before its delayed fission can be distinguished from prompt fission. The recoil length of a short-lived isomer is magnified by geometrical projection and appears as a much longer distance on the detector. With special targets which are plane within ±1μ, the shortest measurable half-life becomes 5 ps if the isomers are produced in α-particle-induced reactions. With this technique the even–even isotopes of Pu were studied in (d,pn), (p,2n), and (α,2n) reactions. The assignment of the isomers is based on excitation functions and cross-bombardments. The measured half-lives were as follows: ^{236}Pu, 40 ± 15 ps; ^{238}Pu, 0.7 ± 0.2 ns; ^{242}Pu, 3.5 ± 0.6 ns; ^{244}Pu, 400 ± 100 ps. The isomers of ^{236}Pu, ^{242}Pu, and ^{244}Pu have not been observed before. It is believed that these isomers represent the lowest state in the second minimum, whereas longer-lived isomers in the same nuclei should be considered as two-quasi-particle excitations in the second minimum. With these data a dependence of fission isomer half-lives on neutron number could be established for even–even isotopes which is similar to the known behavior of fission isomers in odd–even and odd–odd nuclei. The results are included in a general discussion of systematic trends in fission isomer lifetimes. Special attention is paid to the effect the addition of an odd particle has on the half-life of a fission isomer. (6 figures) (auth)

4985 SYMMETRIC AND ASYMMETRIC FISSION OF Ra AND Ac ISOTOPES. Konecny, E.; Specht, H. J.; Weber, J. (Univ., Munich). pp 3-18 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.2); CONF-730823-P2.

Fission probabilities and fragment anisotropies were investigated at low excitation for fission of ^{226}Ac, ^{227}Ac, ^{228}Ac and ^{225}Ra, ^{227}Ra induced on a ^{226}Ra target by direct reactions with a 23.5-MeV ^{3}He beam and an 18-MeV d beam. These results show that the triple-humped character of the mass distribution pertains to low excitation energies where second- and higher-chance fission are energetically excluded. More important, they reveal different thresholds for symmetric and asymmetric fission. In addition, the angular anisotropies for both components close to the fission barrier seem to be different: this finding also suggests that asymmetric and symmetric fission of the nuclei investigated proceed over different saddle points. The fission probability Γ_f/Γ_n increases exponentially for both components, with a much bigger slope for the symmetric one. For ^{227}Ra and ^{228}Ac the fission probability for symmetric fission even exceeds that for asymmetric fission at some few MeV above the barrier. The average kinetic energy is lower for the symmetric than for the asymmetric component and does not change significantly with excitation energy of the fissioning nucleus. On the contrary, for asymmetric fission it decreases with excitation, as observed for fission of actinide nuclei. (auth)

4986 FRAGMENT MASS AND KINETIC ENERGY DISTRIBUTIONS FOR FISSIONING SYSTEMS RANGING FROM MASS 230 TO 256. Unik, J. P.; Gindler, J. E.; Glendenin, L. E.; Flynn; K. F.; Gorski, A.; Sjoblom, R. K. (Argonne National Lab., IL). pp 19-45 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 2); CONF-730823-P2.

Pre-neutron-emission fragment mass and total kinetic energy (TKE) distributions, as well as mass–energy correlations, were obtained for thermal-neutron-induced fission of ^{229}Th, ^{233}U, ^{235}U, ^{239}Pu, ^{245}Cm, ^{249}Cf, and ^{254}Es and spontaneous fission of ^{246}Cm, ^{248}Cm, ^{250}Cf, ^{252}Cf, ^{254}Cf, and ^{256}Fm by using the double-energy method. Post-neutron-emission mass distributions of fragments formed in the thermal-neutron-induced fission of ^{251}Cf, ^{254}Es, and ^{255}Fm and spontaneous fission of ^{253}Es, ^{254}Fm, and ^{256}Fm were obtained radiochemically. These data, covering a wide range of different fissioning systems, make possible detailed examinations of many aspects of the fission process. All the double-energy data were analyzed in a self-consistent manner (identical energy calibration methods, corrected for neutron-emission effects, experimental resolution, fragment energy losses in target materials, etc.) so that the precision of reported $\overline{\text{TKE}}$ values and fragment masses, relative to the energy calibration method used, are believed to be better than ±0.5 MeV and ±0.2 amu. Several of the pre-neutron mass distributions, particularly for ^{229}Th(n,f),

^{235}U(n,f), and ^{248}Cm(sf), exhibit pronounced fine structure. This observed fine structure is discussed in terms of enhanced formation of even-Z fragments in fission, nuclear charge division, and fragment shell structures at large deformations. The total kinetic energy released in the fission of ^{246}Cm and ^{250}Cf resulting from neutron capture is greater than in the respective cases of spontaneous fission. However, the fraction of initial excitation energy appearing as additional $\overline{\mathrm{TKE}}$ in the fission of ^{250}Cf is substantially greater than for ^{246}Cm; this result is consistent with existing neutron emission probability measurements. The neutron emission function $\bar{\nu}$(A) for pre-neutron-emission fragment masses was indirectly determined by comparison of cumulative pre- and post-neutron-emission mass yields for thermal-neutron-induced fission of ^{254}Es and spontaneous fission of ^{252}Cf and ^{256}Fm. The trends in $\bar{\nu}$(A) and the characteristics of the mass distributions as a function of the fissioning nucleus and excitation energy are discussed. (14 figures, 4 tables) (auth)

4987 COMPARISON OF THE FISSION CHARACTERISTICS OF THERMAL-NEUTRON-INDUCED FISSION OF ^{239}Pu AND THE SPONTANEOUS FISSION OF ^{240}Pu. Deruytter, A. J. (EURATOM, Geel, Belgium); Wegener-Penning, G. pp 51-63 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 2); CONF-730823-P2.

The thermal-neutron-induced fission of ^{239}Pu and the spontaneous fission of ^{240}Pu were compared to study the influence of the excitation energy on the fission characteristics. A two-dimensional coincident fragment pulse-height analysis was performed with a 4π Pu source viewed by a surface barrier detector on each side of the foil. The Pu source was a mixture of about 90% ^{240}Pu and 10% ^{239}Pu. The thermal-neutron measurements were performed with a well-thermalized beam of the BR 1 graphite reactor. The ^{240}Pu spontaneous fission experiments were performed with the reactor shut down. In such a method the systematic errors cancel in the comparison. Kinetic energy and mass distributions were obtained for both systems. The average pre-neutron total kinetic energy is found to be higher for thermal-neutron-induced fission, viz: 177.9 ± 0.04 MeV, than the value 176.8 ± 0.14 MeV for spontaneous fission. The indicated errors are statistical. The mass distributions are similar; however, the peak-to-valley ratio is larger, and the peaks are narrower and shifted towards the symmetric point over 1 mass unit for spontaneous fission. Mass distributions for several groups of total kinetic energies of the fragments indicate that with increasing total kinetic energy the mass peaks become narrower, the average heavy mass approaches 132, and apparent fine structure at lower kinetic energies disappears. The fine structure effects in the mass distributions at low total kinetic energies are more pronounced in spontaneous fission. This effect may be due to the fact that, in thermal-neutron-induced fission of ^{239}Pu, 0^+ and 1^+ channels are open. (7 figures, 3 tables) (auth)

4988 SYSTEMATIC ODD–EVEN EFFECT IN THE INDEPENDENT YIELD DISTRIBUTIONS OF NUCLIDES FROM THERMAL-NEUTRON-INDUCED FISSION OF ^{235}U. Amiel, S.; Feldstein, H. (Soreq Nuclear Research Centre, Yavne, Israel). pp 65-94 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.2); CONF-730823-P2.

A detailed analysis of experimental data was found to exhibit a systematically consistent odd–even effect in the independent yield distributions of the nuclides in thermal-neutron-induced fission of ^{235}U. The odd–even effect in the element yield distribution for elements at the fission peaks appeared as a sawtooth structure, in which the amplitudes between the enhanced even-Z yields and the less favored odd-Z yields were ±25% of the mean values. The elements examined constituted ~75% of the fission yield. The distribution of the isotopic yields in many cases was found to have a saw-tooth pattern superimposed on a Gaussian-like shape, where the amplitudes betwen the high even-N and low odd-N values were on the average ≤ ±8% of the mean values. This effect at the light peak nuclides seemed to be unresolved while pronounced at the heavy peak nuclides. The isobaric dispersions were studied in 24 mass chains (14 at the heavy mass peak and 10 at the light peak), and were found to follow the general pattern of a Gaussian with widths varying between 0.45 and 0.8 charge units. The detailed description of the isobaric dispersion was represented by a saw-tooth structure fluctuating with amplitudes of ≥30% around a constant-width Gaussian in which the even-Z nuclides were consistently enhanced. The only appearance of a significant closed-shell effect was observed in ^{134}Te. The fact that the neutron pairing effect in the yields as compared with that of the protons was much smaller is attributed to the evaporation of neutrons during the de-excitation of the fragments, a process which is responsible for "washing out" part of the original neutron pairing effect in the primary fragment formation in fission. The present set of experimental data indicates the relative importance of the individual properties of the fragments versus the collective behavior of the fissioning nucleus, as described by the calculations of deformations of shell-corrected liquid-drop potential energy surfaces. One is also led to conclude that nucleon transfer, visualized by the different charge density of the fragments, takes place before scission and that at scission there is a smaller probability, consistent with energy considerations, of breaking pair configurations. (7 figures, 5 tables) (auth)

4989 YIELDS OF SHORT-LIVED FISSION PRODUCTS IN THE 50-NEUTRON-SHELL REGION IN THERMAL-NEUTRON-INDUCED FISSION OF ^{235}U. Kratz, J. V.; Herrmann, G. (Univ., Mainz). pp 95-113 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.2); CONF-730823-P2.

Radiochemical charge distribution measurements have shown a strong influence of the 50-proton shell on low-energy fission reactions. The possible influence of the 82-and 50-neutron shells on charge distribution is still subject to experimental work. Particularly few data on charge distributions have been published in the 50-neutron-shell region. The reason is mainly that the half-lives of fission products around N = 50 are as short as a few seconds or less, and suitable fast chemical separations have not been developed until recently. The rapid volatilization of arsenic and selenium as hydrides from aqueous solutions was used to identify new short-lived isotopes of germanium, arsenic, and selenium with half-lives down to a few tenths of a second, e.g. 0.3-s ^{87}As and 0.9-s ^{86}As. Half-lives were determined directly by following the decay of prominent γ-ray peaks, by delayed neutron counting, or indirectly by milking of known daughter or granddaughter activities. These techniques were also applied to determine branching ratios within a given β^--decay chain (in the case of isomerism) and from one chain to another (via delayed neutron emission) by measuring delayed neutron yields. With these data taken into account, fractional cumulative yields of arsenic and selenium isotopes were determined via their bromine daughter activities in the chains 83, 84, 85, 87, and 88. The isobaric yield distributions have the same width as the Gaussian distributions found far from closed shells; however, the distributions around mass number 84 are shifted if compared to the position expected by interpolation of adjacent distributions. This shift could indicate a preferential formation of closed-shell fragments in the fission process. It can be shown, however, that this effect can also be explained by a shell-dependent evaporation of prompt neutrons. (8 figures, 3 tables) (auth)

4990 EXPERIMENTAL STUDY OF THE CORRELATION BETWEEN THE NUMBERS OF PROMPT NEUTRONS EMITTED BY THE TWO COMPLEMENTARY FRAGMENTS IN SPONTANEOUS FISSION OF ^{252}Cf. Signarbieux, C.; Rabinet, R.; Nifenecker, H.; Poitou, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 179-189 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974). (In French).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 2); CONF-730823-P2.

The large liquid scintillator method was used to measure the mean values $\bar{\nu}_1$ and $\bar{\nu}_T$ and the variances $\sigma^2(\nu_1)$ and $\sigma^2(\nu_T)$ of the distributions of the number of neutrons emitted per fragment and per fission as function of the mass, A, of one of the fragments and the total kinetic energy, E_K, of both. The data on the mean values $\bar{\nu}_1(A,E_K)$ agree well qualitatively with earlier measurements of Bowman and co-workers except for the mass region above A = 150. On the reasonable assumption that the de-excitation modes of the two complementary fragments are independent, the correlation between the excitation energies of these fragments can be determined very simply from the variance data. For each mass ratio an anticorrelation is observed when the E_K value is fixed; the magnitude of this anticorrelation is maximum around the most probable E_K value and tends towards zero at the limits of the distribution $p(E_K)$. Moreover, the overall correlation of the excitation energy distribution (integrated over all the E_K values) is practically zero for all mass ratios. These results show clearly that the degree of freedom associated with the elongation of the nucleus towards fission is strongly coupled with other degrees of freedom of the system; this coupling means that the rate of evolution of the system could be slow enough to justify the hypothesis of a state of quasi-equilibrium at the scission point. (4 figures) (auth)

4991 MEASUREMENT OF THE MEAN NUMBER OF PROMPT NEUTRONS AND THE MEAN ENERGY OF PROMPT GAMMA RAYS EMITTED DURING RESONANCE-NEUTRON-INDUCED FISSION IN ^{235}U AND ^{239}Pu. Frehaut, J. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France); Shackleton, D. pp 201-210 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974). (In French).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 2); CONF-730823-P2.

By using the 60-MeV linear accelerator at the Saclay Nuclear Research Centre as a pulsed neutron source, the authors measured the variations from resonance to resonance in the mean number, $\bar{\nu}$, of prompt neutrons and the mean energy, $\bar{E}_\gamma$, of prompt gamma radiation emitted during fission of ^{235}U and ^{239}Pu induced by s-wave neutrons. Contrary to other published results, no clear-cut variation in $\bar{\nu}$ for ^{235}U was found. However, anticorrelated fluctuations of $\bar{\nu}$ and $\bar{E}_\gamma$ were observed in the case of ^{239}Pu. These fluctuations, which are independent of resonance spin, may be regarded as a contribution of the $(n,\gamma f)$ reaction. (5 figures) (auth)

4992 FISSION FRAGMENT ISOMERS FROM SPONTANEOUS FISSION OF ^{252}Cf. Clark, R. G. (Univ. of Maryland, College Park); Glendenin, L. E.; Talbert, W. L. Jr. pp 221-248 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 2); CONF-730823-P2.

Isomeric levels, populated before beta decay during the deexcitation of ^{252}Cf fission fragments, were studied by observing the K x rays and gamma rays from the isomeric decay. A six-parameter experiment with high-resolution Si(Li) and Ge(Li) detectors measured photon energies from 10 to 1500 keV and emission times from 1 to 3000 ns after the detection of complementary fission fragment pairs by Si—Au surface barrier detectors. The photon intensity was studied as a function of fragment mass (computed from the complementary fragment kinetic energies), photon energy, and emission time. Half-life and fragment mass assignments were made for all isomeric gamma rays. A four-parameter experiment, using two Ge(Li) detectors, observed coincidences between isomeric gamma rays, and the coincidence information was combined with the assignments and observed K x-ray intensities of the six-parameter experiment and with other work to assign 130 of the transitions to specific nuclei. Previously reported concentrations of the isomeric gamma-ray intensity around masses 98, 108, and 134 are discussed, along with feeding from isomeric levels into ground-state rotational bands in the deformed rare earth region. (14 figures, 2 tables) (auth)

4993 MEASUREMENT OF PERTURBED ANGULAR DISTRIBUTION OF GAMMA RAYS FROM THE SPONTANEOUS FISSION OF ^{252}Cf. Lajtai, A. (Central Research Inst. for Physics, Budapest); Jeki, L.; Kluge, G.; Vinnay, I.; Engard, F.; Dyachenko, P. P.; Kuzminov, B. D. pp 249-256 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 2); CONF-730823-P2.

The angular and energy distributions of the gamma rays emitted by fission fragments from the spontaneous fission of ^{252}Cf were measured by using platinum or iron source backing and NaI(Tl) or Ge(Li) detectors. The average anisotropy of the gamma rays relative to the direction of fragment flight, expressed as $A = [I(180°) - I(90°)]/I(90°)$, was 11 ± 1% in the gamma energy interval 120 keV to 1.5 MeV and 18 to 22% at energies from 350 to 850 keV if the platinum backing and NaI(Tl) detector are used. For iron backing the anisotropy value decreases under the same conditions to 5.2 ± 0.1% at energies from 120 keV to 1.5 MeV and to 5.1 ± 0.2% if a magnetic field is applied in the direction normal to the plane of fission in which the fragments and gamma rays are being counted. By assuming a set of most plausible values for the lifetime of fission gamma rays and for the internal magnetic field at the iron site involved, average g factors for the fission fragments were evaluated from the measured attenuation. The measurements with the Ge(Li) detector show anisotropies which can be determined for about 30 gamma peaks and also the g factors for specific gamma transitions seem able to be evaluated. This work is still in progress. (5 figures, 1 table) (auth)

4994 PROMPT ELECTRONS EMITTED FROM INDIVIDUAL FRAGMENTS IN NEUTRON INDUCED FISSION. Khan, T. A. (Pakistan Inst. of Nuclear Science, Nilore); Horsch, F. pp 257-266 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347(Vol. 2); CONF-730823-P2.

A three-parameter experiment was performed in which the energies of coincident fragment pairs and internal conversion electrons emitted within 1.8 ns after the thermal-neutron-induced fission of ^{235}U were recorded event by event. The fragment kinetic energies were used for mass identification. The self-consistency of the values of the electron energy, gamma-ray energy as determined in previous experiments and fragment charge, and the agreement with x-ray data, were used to identify the atomic numbers of the fragments. Analysis of the spectra resulted in the assignment of many transitions to new isotopes as well as improvement in or confirmation of many assignments from the ^{252}Cf spontaneous fission data. Limited information on the multipolarities of the transitions in even nuclei is presented. The relative yield of electrons per fragment indicates softness to deformation in the mass region 100 to 110. An examination of the 2^+ to 0^+ level systematics of neighboring even nuclei suggests a transition from vibrational to rotational behavior in the light fragments between neutron numbers 58 and 60. (auth)

4995 RECENT STUDIES ON POLAR EMISSION. Piasecki, E.; Dakowski, M.; Kordyasz, A. (Inst. of Nuclear Research, Swierk, Poland). pp 383-388 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.2); CONF-730823-P2.

The intensities and spectra of the polarly emitted protons, deuterons, tritons and ^{6}He particles were investigated in the slow-neutron fission of ^{235}U. The intensities of these particles relative to the alpha-particle polar emission are 21.5 ± 1.5, 2.75 ± 0.5, and 7.3 ± 0.9% and the mean kinetic energies are equal to 10 ± 0.5, 11 ± 0.5, and 13 ± 0.5 MeV, respectively. Not one polar ^{6}He event was detected for 1600 polar alphas. These results are compared with the theoretical predictions based on the evaporation hypothesis of polar emission. The phenomenon can partly be explained by using this hypothesis, but some puzzling disagreements with theory were also observed. (4 figures) (auth)

4996 ENERGY AND ANGULAR DISTRIBUTIONS OF ALPHA PARTICLES IN THE FISSION OF ^{252}Cf. Tsuji, K.; Katase, A.; Yoshida, Y.; Katayama, T.; Toyofuku, F.; Yamamoto, H. (Kyushu Univ., Fukuoka). pp 405-416 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 2); CONF-730823-P2.

The energy distributions of the alpha particles emitted in the fission of ^{252}Cf were measured with a good angular resolution to investigate the dependence on the angle between the alpha particle and the light fragment. The energies of one of the fission fragments and the alpha particle and the time difference between the signals for the two particles were measured and recorded event by event. The time resolution was about 2 ns, and the accidental events could be eliminated sufficiently. The light and heavy fragments were sorted by kinetic energy. The energy spectra were obtained at 9 angles from 65° to 105° and were well fitted by the Gaussian distribution for energies above about 13 MeV for each angle. The values of the most probable energy were found to have a minimum value of 14.0 MeV at 84° and increase rapidly with angle on both sides of 84°. The widths of the energy distributions were nearly independent of the angle, and the fwhm value was about 8.6 MeV. The most probable angle of alpha particles with energy above 12.5 MeV with respect to the light fragment was found to be 84.3°, and the fwhm value of the angular distribution was about 18°. The alpha-particle energy distributions were calculated by the Monte Carlo method in the three-point-charge approximation. In this calculation, the distributions of the mass ratio and the total kinetic energy were taken into consideration, together with the distributions of the initial emission position, initial kinetic energy, and emission angle of the alpha particle. The energy spectra, which were very similar to one measured at 90°, were obtained for some values from 21.5 fm to 26 fm of the distance, D_f, between two fission fragments at the emission of the alpha particle. From the comparison of the calculated distributions with the experimental ones for other angles, the value of about 22 fm for D_f was seen to be most nearly consistent with the present experimental results. (8 figures, 2 tables) (auth)

4997 CONNECTION BETWEEN LRA TO BINARY FISSION CROSS-SECTION RATIO FOR RESONANCE AND THERMAL-NEUTRON-INDUCED FISSION IN ^{239}Pu AND RESONANCE SPINS.

Deruytter, A. J. (EURATOM, Geel, Belgium); Becker, W.; Wagemans, C. pp 417-434 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 2); CONF-730823-P2.

The LRA to binary fission cross-section ratio was measured at an 8-m flight-path station of the CBNM LINAC. The heavy fission fragments in binary fission and the energetic light particles ($E_\alpha > 15$ MeV) in LRA fission were subsequently counted with banks of solid state detectors on both sides of a double-faced ^{239}Pu sample, as a function of the incident neutron energy. Two measurements were performed, one to cover the neutron energy range up to 50 eV and the other to obtain accurate information through the 0.3-eV resonance. The T/B values were obtained by a division of the resonance areas in the first measurement. In the low-energy run the TOF spectra were divided in energy intervals from 0.02 to 1 eV, and the ratios of the areas in the corresponding TOF spectra were calculated. The data analysis yielded for the 15.5-eV resonance a T/B value which was about 10% higher. In the low-energy region no inconsistency was found with a unique value for the ratio. On the other hand, a careful analysis was performed of the accurate low-energy fission cross section of ^{239}Pu obtained at CBNM, Geel, below 20 eV with the use of an interference formula. It was possible to show that this low-energy fission cross section can only be adequately described when the 15.5-eV resonance has a spin and parity 0^+ and the other positive energy resonances below 20 eV are 1^+. These measurements suggest that a high T/B value is correlated with a 0^+ resonance. (6 figures, 5 tables) (auth)

4998 CHARGE DISTRIBUTION OF THE FRAGMENTS EMITTED IN TERNARY FISSION. Nifenecker, H. (Univ. of California, Berkeley). pp 435-449 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 2); CONF-730823-P2.

It is possible, in principle, to derive the charge distribution of the fragments produced in LRA fission of ^{252}Cf by comparing the K x-ray spectra observed in binary and LRA fission. However, it has been shown by Watson that such a procedure is inaccurate because the K x-ray emission probability depends on the isotopic distributions, which should be somewhat different in binary and LRA fission. It was found that the total number of prompt neutrons emitted by the fragments measured in coincidence with the K x rays gives a good indication of the extent of this dependence of the K x-ray emission probabilities on the isotopic distributions. This dependence is not strong for most of the light fragment isotopes and for the higher Z region of the heavy group. On this basis, it was possible to derive the elemental yields for LRA fission in the applicable regions. The K x-ray emission probabilities are higher in ternary fission for the lower Z region of the heavy fragments. This difference indicates that, in this region, the ternary fragments are more neutron-rich than the binary fragments. These experimental results are compared with predictions based on different hypotheses regarding the alpha formation mechanism. (8 figures, 1 table). (auth)

4999 ASYMMETRY OF THE PHOTOFISSION OF ^{237}Np AS A FUNCTION OF THE MAXIMUM BREMSSTRAHLUNG ENERGY. Kondrat'ko, M. Ya.; Korinets, V. N.; Petrzhak, K. A. Sov. At. Energy (Engl. Transl.); 34: No. 1, 69-70(Jan 1973).

Translated from At. Energ. (USSR); 34: No. 1, 52-53(Jan 1973).

The yields of several products of the symmetric and approximately symmetric fission of ^{237}Np by bremsstrahlung were measured for maximum energies ranging between 10 and 24 MeV. The work was done by a radiochemical method. The error in measuring the energy was 0.15 MeV. The fragments ^{115,117}Cd, ^{109,112}Pd, and ^{111,113}Ag were measured relative to ^{140}Ba. The peak-to-valley ratio is plotted and compared with similar results for ^{235}U. The relative yields of mass chains 112, 113, 115, and 117 are equal and increase rapidly with energy; the yields of 109 and 111 rise less steeply. (1 figure, 1 table) (RWR)

Nuclear Theory

Refer also to abstracts 4513 and 4764.

5000 (ANL-8113) ARGONNE NUCLEAR SHELL-MODEL SYSTEM. Gloeckner, D. H. (Argonne National Lab., Ill. (USA)). Sep 1974. Contract W-31-109-eng-38. 114p. Dep. NTIS $5.45.

This report describes a system of programs that perform nuclear shell-model calculations on the IBM/360-model computers. The overall system organization is explained, and a discussion is given on how a nuclear structure problem is broken down into program pieces. Each program is described, and examples are given. (auth)

5001 (BNL-tr-576) GAMMA-RAY DECAY OF NEUTRON RESONANCES. Becvar, F. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. Translated from a Preprint from Mezhdunarodnaya Shkola po Struktura Yadra, Alushta, April 2-19, 1974. 32p. Dep. NTIS $4.75.

The use of the (n,γ) reaction to study nuclear structure is first briefly discussed. Attention is then directed to the main topic of the paper—the gamma decay of neutron resonances and the capture mechanism. Predictions and failings of the statistical model are outlined, and then the fluctuations of partial radiation widths are analyzed, primarily on the basis of the Porter-Thomas distribution. The ^{149}Sm(n,γ) reaction is discussed in this connection. Properties of the resonance decay which are directly related to specific models of the capture mechanism are then considered, and attention is directed to the basic principles of the Lane-Lynn theory. In conclusion, a method of describing highly excited states based on a semimicroscopic approach due to Solov'ev is described. (6 figures) (RWR)

5002 (CONF-740934-1) SUCCESSES AND FAILURES OF THE NUCLEAR SHELL MODEL. McGrory, J. B. (Oak Ridge National Lab., Tenn. (USA)). 1974. 34p. Dep. NTIS $4.75.

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The usefulness and significance of the conventional nuclear shell model in studies of nuclear phenomena in terms of microscopic properties are reviewed. The emphasis is on the success or failure of the shell model, in a phenomenological sense, in describing systematic patterns of nuclear phenomena. First, conventional shell-model calculations in the s-d and f-p shell are discussed, wherein ^{16}O and ^{40}Ca are treated as closed cores. Most of the "realistic" interaction calculations are in this mass region, and comments on the usefulness of the shell model in testing these interactions can be made. Theory and experiment are compared as to energy levels, electromagnetic moments, and electromagnetic transition rates. Next, shell-model calculations of two-nucleon-transfer cross sections are considered. Such reactions are relatively sensitive to two-particle correlations in the wave functions, and so may be a more challenging test of particular shell models. Finally, the application of the conventional shell model to states which involve core excitation around ^{16}O and ^{40}Ca is discussed. (5 figures, 12 tables) (RWR)

5003 (CONF-740934-2) NUCLEAR GAMMA AND BETA DECAY. Lawson, R. D. (Argonne National Lab., Ill. (USA)). 1974. 22p. Dep. NTIS $4.25.

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

Some aspects of nuclear beta and gamma decay are discussed, and the places where additional experimental information is needed or where theoretical problems still exist are stressed. The material is divided into two parts: first, those rules which are geometrical in origin are discussed; and second, results arising from isospin are considered. It is shown that a measurement of the $^{209}_{81}\mathrm{Tl}_{128}$ beta decay to the $1/2^+$ state in $^{209}_{82}\mathrm{Pb}_{127}$ could yield important information about a possible difference in the radii of the neutron and proton single-particle potential wells. Further, the problem of the anomalously fast $\Delta T = 0$ E1 transitions in 4n nuclei is discussed. (3 figures, 5 tables) (auth)

5004 (COO-1764-209) PROGRESS REPORT FOR THEORETICAL AND HIGH ENERGY PHYSICS PROGRAMS, SEPTEMBER 1, 1973 THROUGH AUGUST 31, 1974. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). [nd]. Contract AT(11-1)-1764. 38p. Dep. NTIS $5.00.

Research in nuclear physics and elementary particle physics is described. The nuclear research is all theoretical, but the high energy research is both theoretical and experimental. The report is organized according to this three-way division of research activities. It is noted that some of the results presented here are tentative and may be modified before publication. (auth)

5005 (LBL-2970) SIMILARITIES AND DIFFERENCES BETWEEN VOLUME-CHARGED (NUCLEAR) DROPS AND CHARGED CONDUCTING (RAIN) DROPS. Tsang, C. F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1974. Contract W-7405-eng-48. 22p. (CONF-740837-1). Dep. NTIS $4.25.

From international colloquium on drops and bubbles; Pasadena, California, USA (28 Aug 1974).

The liquid drop model of the nucleus has been explored in the last forty years in the study of nuclear fission and, more generally, nuclear deformation energy surfaces. This model assumes the nucleus to be an incompressible drop with charges uniformly distributed throughout the volume. A parallel study was made of a charged conducting drop with charges residing on the surface of the drop. This is the case of rain drops in an electrified cloud. Stable and unstable shapes of equilibrium were calculated, and their properties were examined. Fundamental differences in the stability properties of the two types of drops are brought out, and show up most significantly in their stability against reflection asymmetry. Certain similarities are also found, particularly in the ellipsoidal deformation of the drops, as well as their division into equal droplets. Both these similarities and differences are described and discussed. (8 figures) (auth)

5006 (RT/FI-(74)36) CERBERO: A FORTRAN PROGRAM FOR THE CALCULATION OF NUCLEAR REACTION CROSS SECTIONS. Fabbri, F.; Reffo, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Aug 1974. 35p. Dep. NTIS (US Sales Only) $4.75.

The CERBERO code can calculate a complete, consistent set of binary cross sections on the basis of the optical model and of the statistical model. Only spherical local potentials are allowed. (auth)

5007 (STI/PUB-347 (Vol. 1)) PHYSICS AND CHEMISTRY OF FISSION, 1973. Volume I. Proceedings Series. Proceedings of the Third IAEA Symposium Held in Rochester, New York, August 13-17, 1973. (International Atomic Energy Agency, Vienna (Austria)). May 1974. 588p. (In French and English). (CONF-730823-(P1)). IAEA $26.00.

Separate abstracts were prepared for 19 of the items in this volume. The remaining 15 have already appeared in NSA with the following abstract numbers: 28: 19977, 28: 19978, 28: 19992, 28: 20004, 28: 23068, 28: 23077, 28: 26227, 28: 28789, 28: 28879, 28: 31558, 29: 11558, 29: 17277, 29: 25639, 30: 05127, and 30: 08503. (RWR)

For abstracts of individual papers see: 4963, 4977–4984, and 5019–5028.

5008 (UCRL-76065) HIGHLY EXCITED NUCLEAR MATTER. Chapline, G. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1974. 25p. Dep. NTIS $4.25.

The subject of "head-on" collisions between heavy nuclei in which there is considerable momentum exchange between the projectile and target nuclei is addressed. If the initial kinetic energy of the projectile nucleus is in the range 1 to 2 GeV per nucleon, then a large transfer of momentum between projectile and target could lead to energy densities in the c.m.s. which are much larger than anything produced heretofore in the laboratory. The properties of hot nuclear matter are discussed; at temperatures in excess of 100 MeV, mesons are produced copiously. It is assumed that, in accordance with classical hydrodynamics, the nuclear matter in the colliding nuclei is compressed as a result of passing through a shock wave; this compression is analyzed in some detail. Possibilities of abnormal nuclear states are discussed. If it happens that excited baryon states can exist at densities higher than normal nuclear density, then the rapid expansion of the compressed nuclear matter could lead to nonequilibrium states in which population inversions exist; this situation suggests the possibility of pion lasers. Applications of these remarks are made to astrophysics, in particular, to neutron stars and the early universe. (4 figures) (RWR)

5009 POSSIBILITY OF THE UNIFIED DESCRIPTION OF NUCLEAR LEVELS AND EXPERIMENTS ON THE ALPHA-PARTICLE AND ELECTRON SCATTERING. Afanas'ev, G. N.; Eliseev, S. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol.; 5B: No. 5, 731-739(1974). (In Russian).

The possibility of describing of nuclear levels, alpha-particle and electron scattering experiments within the framework of a unique model is investigated. The nuclear density was generated by single particle potential for electron scattering. For the scattering of alpha-particles on nuclei, the elementary amplitude of alpha-nucleon scattering was used. (auth)

5010 AN EFFICIENT METHOD FOR THE ANALYSIS OF DATA FROM PERTURBED ANGULAR CORRELATION AND MULTIPLE-LIFETIME EXPERIMENTS. Bargholtz, C. (Stockholm Univ. (Sweden). Fysiska Institutionen). Nucl. Instrum. Methods; 120: No. 1, 121-124(15 Aug 1974).

A method for the analysis of data from perturbed angular correlation, or distribution experiments is described. The method allows for the presence of a prompt admixture, and is also suited for the analysis of lifetime data involving up to three different decay constants. A computer code utilizing this method of analysis has been developed and extensively tested. (auth)

5011 NUCLEON DENSITY DISTRIBUTION IN THE STATISTICAL MODEL OF A NUCLEUS. Antonchenko, V. Ya.; Simenog, I. V. (Inst. of Theoretical Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 7, 1071-1074(Jul 1974). (In Russian).

Analysis of the inhomogeneity of nucleon density distributions over the nucleus volume (which depends on the variant of nuclear forces) is performed in terms of the statistical model. (auth)

5012 LONG-RANGE PARITY-VIOLATING INTERNUCLEON POTENTIAL MEDIATED BY NEUTRAL CURRENTS. Ragutt, B. (Ruhr Univ., Bochum, Ger.); Reid, J. H.; Schuelke, L. Lett. Nuovo Cim.; 11: No. 8, 445-448(26 Oct 1974).

The contributions to higher order in weak or electromagnetic coupling constants are extended to the case of nuclear reactions. The relative strengths of the potentials are shown. The long-range parity-violating nucleon–nucleon interaction is considered. (JFP)

5013 ONE-FAMILY POTENTIALS THAT ARE EQUIVALENT TO THE HARD-CORE POTENTIALS. Plyuyko, V. A.; Olkhovskii, V. S. (Kiev State Univ.). Lett. Nuovo Cim.; 11: No. 8, 431-436 (26 Oct 1974).

A family of potentials with the radial distribution concentrated in one point is considered. The equivalence of these potentials centered at the core boundary to the hard-core potentials is proven for some class of the central outside potentials. Then the partial-transition operator on and off the energy shell is derived for these potentials. (JFP)

5014 PRODUCTION AND DECAY OF COMPOUND NUCLEI IN REACTIONS INDUCED BY HEAVY IONS. Barashenkov, V.S.; Zheregi, F. G.; Il'inov, A. S.; Toneev, V. D. (Joint Institute for Nuclear Research, Dubna). Sov. J. Part. Nucl. 5: No. 2, 192-210(Oct 1974).

A statistical model of nuclear reactions induced by heavy ions via a stage of compound–nucleus production is considered. The probabilities of the various channels are discussed in detail with account taken of the angular momentum of the excited nucleus. Particular attention is paid to calculations of the ratio $\Gamma_{n}\cdot(\Gamma_f)^{-1}$ of the evaporation and fission widths. All the statistical calculations are performed by the Monte Carlo method, which turns out to be a very effective method of analyzing the decays of excited compound nuclei. The accuracy of the statistical model and the limits of its applicability are assessed by comparison with experiment. (auth)

5015 CONFIGURATION MIXING EFFECTS IN SINGLE–NUCLEON TRANSFER REACTIONS. Bang, J.; Bunakov, V.E.; Gareev, F.A.; Schulz, H. (N. Bohr Institute, Copenhagen, Denmark). Sov. J. Part. Nucl. 5: No. 2, 103-121 (Oct 1974).

The present status of the theory of single–nucleon transfer reactions to bound and unbound states of the final nucleus is considered. Various methods are described for solving the equations for the form factors of single–nucleon transfer reactions within the framework of various model representations of the nuclear structure. It is shown that configuration mixing effects and allowance for the continuum can play a significant role. (auth)

5016 QUASIELASTIC ELECTRON SCATTERING AND NUCLEAR STRUCTURE. Bagradov, G.M.; Gorchakov, V.V. (Nuclear Research Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Part. Nucl. 5: No. 2, 122-132 (Oct 1974).

Inelastic electron—nucleus collisions are considered on the basis of many–body theory without using any model approximations. The general properties of the average nuclear field for quasiparticles are considered. Owing to correlative interactions, this field turns out to be complex and energy dependent. The character of the spectrum of the residual nucleus in (e,e'p) reactions is explained quantitatively and a phenomenological approach to the description of hole excitations is proposed. Rescattering effects in (e,e'n) reactions are considered briefly. (auth)

5017 ATTENUATION OF THE CORIOLIS INTERACTION WITHIN THE CRANKING MODEL. Ring, P. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Mang, H.J. Phys. Rev. Lett. 33: No. 19, 1174-1177 (4 Nov 1974).

The description of strongly distorted rotational bands within the cranking model allows an interpretation of the attenuation factors used in the particle–plus–rotor model. It turns out that they are not very much influenced by the residual interaction, but are strongly dependent on the angular momentum. A simple model is proposed to calculate distorted spectra which is in rather good agreement with the experimental data and with the fully self–consistent calculation. (auth)

5018 SINGLE PARTICLE POTENTIAL IN POLARIZED NUCLEAR MATTER. Dabrowski, J. (Inst. for Nuclear Research, Warsaw); Haensel, P. Can. J. Phys.; 52: No. 18, 1768-1799(15 Sep 1974).

The problem of the single particle potential U in isospin and spin polarized nuclear matter, i.e. in nuclear matter with neutron excess and nonvanishing spin, is treated within the frame of the K matrix theory. General expressions for the isospin, spin, and spin-isospin parts of U, U_τ, U_σ, and $U_{\sigma\tau}$ are obtained with the help of K matrices which depend on two Fermi momenta. The σ and $\sigma\tau$ parts have scalar and tensor components: $U_{\sigma s}$ and $U_{\sigma t}$, and $U_{\sigma\tau,s}$ and $U_{\sigma\tau,t}$. These general expressions are specialized for nucleons at the Fermi surface. With suitable approximations, numerical values for $U_\tau(k_F)$, $U_{\sigma s}(k_F)$, and $U_{\sigma\tau,s}(k_F)$ are obtained for the Brueckner–Gammel–Thaler and the Reid soft core nucleon–nucleon interactions. The tensor components, $U_{\sigma\tau}$ and $U_{\sigma\tau,t}$, are estimated to be much smaller than the corresponding scalar components. The rearrangement effects turn out to be very important. At higher nucleon energies the τ, σ, and $\sigma\tau$ parts of U are calculated in the phase shift approximation with the Yale and Livermore phase shifts. The agreement of the calculated value of U_τ with experiment is satisfactory. The calculated values of $U_{\sigma s}$ and $U_{\sigma\tau,s}$ suggest that, in certain cases, a scalar spin–spin part of the optical potential is strong compared to other theoretical estimates, which seems to agree with some of the experimental results. (auth)

5019 CALCULATION OF FISSION BARRIERS. Moeller, P.; Nix, J. R. (Los Alamos Scientific Lab., NM). pp 103-143 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol. 1); CONF-730823-P1.

Recent advances in the calculation of the nuclear potential energy of deformation, including both self-consistent microscopic methods and the macroscopic–microscopic method, are reviewed. Particular attention is paid to the steps that are involved in calculating the potential energy according to the latter method. These steps include specifying the nuclear shape, calculating the macroscopic (liquid-drop) energy, generating the single-particle potential, solving the Schrödinger equation, and calculating the microscopic (shell and pairing) corrections. The results of the new calculations that have been performed recently at Los Alamos are then presented and compared. In the first calculation, the nuclear shapes are specified in terms of smoothly joined portions of three quadratic surfaces of revolution; this parametrization permits the calculation of the potential energy all the way to the scission point. The extrema in the potential-energy surfaces are determined by varying independently three of the coordinates in this parametrization; the ground-state energy is determined also by use of an alternative parametrization. The macroscopic energy is calculated from the droplet model of Myers and Swiatecki, which includes higher-order terms in $A^{-1/3}$ and in $[(N-Z)/A]^2$ than are retained in the liquid-drop model. The microscopic shell and pairing corrections are calculated by means of Strutinsky's method from the single-particle levels of a diffuse-surface folded Yukawa single-particle potential. A new set of potential parameters is used, which was obtained from adjustments to experimental single-particle levels in heavy deformed nuclei and from statistical calculations. The second new calculation is performed with the modified oscillator potential, and is similar to a previous calculation with this potential except that the droplet model is used in place of the liquid-drop model. These and earlier calculations provide an understanding and unification of many varied phenomena associated with nuclear shape changes: nuclear ground-state masses and deformations, second minima in the fission barriers of actinide nuclei, fission-barrier heights, and fission-fragment mass distributions. For the lighter actinide nuclei, the asymmetric second saddle point is split into two individual saddle points separated by an asymmetric third minimum; this finding possibly resolves the thorium anomaly. The calculated energies of the local minima and saddle points in the potential-energy surfaces reproduce the experimental values to within an accuracy of about 1 MeV, although larger systematic errors are still present in some cases. The calculated properties of the saddle points also reproduce qualitatively the main features of experimental fission-fragment mass distributions. (18 figures, 107 references) (auth)

5020 FISSION BARRIERS FOR HEAVY ELEMENTS WITH QUADRUPOLE, HEXADECAPOLE, AND AXIALLY ASYMMETRIC DISTORTIONS TAKEN INTO ACCOUNT SIMULTANEOUSLY. Larsson, S. E.; Leander, G. (Univ., Lund, Sweden). pp 177-202 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.1); CONF-730823-P1.

Nuclear potential energy surfaces were calculated on the basis of the modified oscillator model by means of the Strutinsky shell-correction method. The deformation energies of nuclei in the actinide region were investigated. The shapes of the nuclei studied were described in terms of quadrupole (ϵ_2), hexadecapole (ϵ_4), and axially asymmetric (γ) deformations. The effect of the γ degree of freedom on the fission barriers was studied in detail. Special emphasis was put on the calculations of the simultaneous effect of γ deformations and hexadecapole deformations on saddle-point deformations for the inner barrier of the two peak barriers. The height of the inner barrier for heavy actinide elements was found to be reduced by up to 2.3 MeV. As a consequence, the lifetimes will also be reduced by inclusion of the γ degree of freedom. Lighter elements such as Th and those lighter than Th seem, however, to be unaffected by axially asymmetric distortions. Furthermore, both the ground state and the isomeric state for the nuclei studied are stable with respect to axially asymmetric deformations. A large part of the emphasis of the present study is on an accurate evaluation of the Coulomb energy with ϵ_4 and γ simultaneously taken into account, which has not been done up to now. In the general case with axially asymmetric nuclear shapes, the Coulomb energy can be expressed as a six-dimensional integral. This six-dimensional volume integral, however, can be reduced to a four-dimensional integral over the surface by the use of Gauss' divergence theorem. The four-dimensional integral was evaluated by numerical methods. (9 figures, 2 tables) (auth)

5021 TREATMENT OF SHELL AND PAIRING ENERGIES WHEN THE LIQUID DROP PARAMETERS ARE REFITTED TO REPRODUCE THE EXPERIMENTAL BARRIER HEIGHTS. Bengtsson, R. (Lund Inst. of Tech., Sweden). pp 203-220 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.1); CONF-730823-P1.

Some less satisfactory aspects of the microscopic–macroscopic nuclear model are discussed, and alternative ways for treating some details in the model are suggested. The prevailing procedure for calculating shell energies, i.e. the Strutinsky procedure, but also the recently developed temperature–entropy method, both require that a great number of excited states are known. Many of these only appear in the theoretical model but do not exist as bound states in real nuclei, and are thus not relevant. An alternative method is presented here which exploits a smoothing of the occupied levels only, over a large number of deformations. The result of this procedure is a set of "smooth" single-particle levels for each of the considered deformations. The shell energy, which for each deformation is calculated as the sum of the energies of the occupied original levels minus the sum of the "smooth" levels, does not, according to preliminary calculations, deviate much from the Strutinsky shell energy. A similar procedure is applied to the pairing energy, prescribing that from the pairing energy a "smoothed" deformation-dependent mean value of the pairing energy should be subtracted. The most frequently used assumptions about the pairing strength, namely G = const. and G ~ nuclear surface, give a smooth pairing energy, which is either constant or has the form of a surface energy. The advantage of subtracting a smooth pairing energy is that the macroscopic (liquid-drop) energy becomes the same, independent of the assumption about the pairing strength, a desired effect which cannot be obtained otherwise. The rightness of introducing a smooth pairing energy is discussed by means of refitted liquid-drop parameters. (12 figures) (auth)

5022 TEST OF STRUTINSKY'S METHOD USING HARTREE–FOCK RESULTS. Brack, M. (State Univ. of New York, Stony Brook); Quentin, P. pp 231-248 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.1); CONF-730823-P1.

New results of Hartree–Fock (HF) calculations are used to estimate the validity of Strutinsky's shell-correction method in a way which is independent of the shell and liquid-drop models usually involved. Strutinsky writes the total binding energy, E, of a nucleus as the sum of a classical liquid-drop(LD)-model energy, E_{LD}, and a shell-correction energy, δE, which is extracted from a sum of shell-model energies, ϵ_i. Here the HF energy is decomposed into three terms: $E_{HF} = \overline{E} + \delta E_1 + \delta E_2$, where $\overline{E}$ is an average binding energy, δE_1 is a first-order shell correction, and δE_2 contains all higher-order corrections, which usually are neglected in the Strutinsky method. By explicitly calculating E_{HF}, $\overline{E}$, and δE_1, these higher-order corrections are evaluated, and the reliability of the shell-correction method from the HF point of view is estimated. The HF results were obtained by using the effective δ interaction of Skyrme in a new parametrization (SIII), which was recently demonstrated to give excellent fits to experimental ground-state energies, deformations and radii throughout the periodic table. A quadratic constraint of the quadrupole moment, Q, was used to obtain deformation energy curves. Pairing effects were included. After the self-consistent density matrix, ρ, is calculated, its average part, $\bar{\rho}$, is determined by the usual energy-averaging procedure. The HF energy can then be decomposed into the three terms stated above, of which $\bar{\bar{E}}$ is solely dependent on smooth quantities like $\bar{\rho}$, δE_1 contains the first-order and δE_2, all higher-order terms in $\delta\rho = \rho - \bar{\rho}$. As a result of these computations, it is found that the quantity $\bar{\bar{E}}$ indeed behaves exactly like a LD-model energy as a function of deformation. This, in itself, strongly confirms Strutinsky's renormalization method. The corrections δE_2 are found to have values of ~0.5 to ~3.0 MeV for nuclei with $A \geq 100$. Since only their oscillations contribute to the shell corrections, a reliability of the Strutinsky-calculated shell corrections to ground-state energies of ~1 to 2 MeV is concluded for medium and heavy nuclei. Similarly, the Strutinsky-calculated fission barriers are found to be affected by less than ~1 MeV. Fission lifetime estimates are expected to be lowered by inclusion of the second-order correction. (6 figures, 1 table) (auth)

5023 ROLE OF SYMMETRY OF THE NUCLEAR SHAPE IN ROTATIONAL CONTRIBUTIONS TO NUCLEAR LEVEL DENSITIES. Bjoernholm, S. (Univ. of Copenhagen); Bohr, A.; Mottelson, B. R. pp 367-374 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.1); CONF-730823-P1.

In nuclei that have static deformations, the level density is appreciably greater than that for spherical nuclei because of the contribution of the low-energy rotational levels. The magnitude of this effect depends on the symmetry of the nuclear shape, which determines the collective rotational degrees of freedom. A number of symmetry types are considered that may be relevant for the shape of nuclei in the ground states as well as at the saddle point for fission. The transition between systems with different symmetries can be studied in terms of the effect of the collective shape oscillations on the level densities. (auth)

5024 DYNAMICS OF FISSION IN THE SUBBARRIER REGION OF DEFORMATION. Pauli, H. C.; Ledergerber, T. (Univ., Basel). pp 463-501 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.1); CONF-730823-P1.

A solvable model for the dynamics of fission is formulated. It is argued in which phase the process is likely to be adiabatic and in which not. This model is checked by calculating the lifetime for spontaneous fission from the ground state and from the shape-isomeric state. Reasonable agreement with experiment is found. The discrepancies are understood and can be improved in future calculations, presumably to give predictive power to these methods. It is claimed that fission barriers are dynamic (not static) quantities and the pre-formation of the nascent fragments arises in the parent nucleus around the outer barrier. (21 figures, 1 table) (auth)

5025 CONSERVATION OF SINGLE PARTICLE QUANTUM NUMBERS IN FISSION. Boneh, Y. (Nuclear Research Centre, Negev, Israel); Fraenkel, Z.; Paltiel, Z. pp 515-522 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.1); CONF-730823-P1.

It is shown in a calculation of single-particle energies for a finite potential well that the total energy of the nucleus at scission is smaller for an asymmetric scission configuration than for a symmetric one if the single-particle quantum numbers are conserved between the saddle point and the scission point. A dynamical model is used to investigate the problem of the conservation of these quantum numbers in the transition from the saddle point to the scission point as a function of the time scale of this transition. The initial shape of the potential is the saddle point shape of the nucleus (A, Z) as predicted by the liquid drop model. The shape of the potential is changed continuously as a function of time to that of the scission configuration. The time-dependent Schrödinger equation is solved for the transition, and in this way the nuclear configuration at the scission point is obtained. On the basis of the present calculation, the single-particle quantum numbers appear to be partially conserved in the saddle-to-scission transition. Thus, the mass asymmetry at scission may in part be the result of dynamical effects of the fission process. Another consequence of the partial conservation of the single-particle quantum numbers is that the saddle-to-scission transition excites single-particle degrees of freedom in the nucleus or, in liquid-drop-model language, the transition causes viscous heating of the nucleus. (3 figures, 2 tables) (auth)

5026 FIRST ESTIMATES OF THE NUCLEAR VISCOSITY CONSTANT FROM THE DAMPING OF THE FISSION DYNAMICS AND FROM THE WIDTHS OF β-VIBRATIONS AND GIANT DIPOLE RESONANCES. Wieczorek, R.; Hasse, R. W.; Suessmann, G. (Univ., Munich, Garching, Ger.). pp 523-532 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.1); CONF-730823-P1.

By using three different approaches the nuclear viscosity constant of heavy nuclei is estimated to be $\eta \simeq 10^{-23}$ MeV $\cdot$ s $\cdot$ fm^{-3} $\simeq 10^{10}$ poise. The dissipation energy $-\dot{E}_{diss} = \Sigma Z_{ij}\dot{\alpha}_i\dot{\alpha}_j$ (Z_{ij} are the hydrodynamical viscosity coefficients depending on the deformation coordinates α_i) is integrated in a dynamic fission model for various paths from saddle to scission and equated to an assumed value of 10 MeV obtained from experimental data; the widths of the higher vibrational states in the first minimum are interpreted as damping resulting from coupling into the second minimum and the fission continuum; the widths of the giant dipole resonances are explained by damping of the hydrodynamical flow. (3 figures) (auth)

5027 COMPRESSIBILITY IN NUCLEAR COLLECTIVE DYNAMICS. Griffin, J. J. (Univ. of California, Berkeley); Kan, K. K. pp 533-545 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.1); CONF-730823-P1.

Because the energy of nuclear matter increases very rapidly with changes in density, the nucleus as a fluid is generally assumed to be incompressible. This paper proposes that this assumption is valid only on the average. It is shown that to impose it as a microscopic identity is inconsistent with a realistic description of finite nuclei and precludes the consideration of certain phenomena which may play an essential role in collective dynamics. (auth)

5028 UNIFIED THEORY OF LOW-ENERGY FISSION AND FISSION MODELS. Noerenberg, W. (Univ., Heidelberg). pp 547-567 of Physics and Chemistry of Fission, 1973. Vol. I. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.1); CONF-730823-P1.

An S-matrix formulation of the induced fission $P + T \rightarrow C \rightarrow F_1 + F_2$ is presented by introducing scattering states $|c\epsilon_c^+>$ of the target–projectile system, bound states $|\lambda>$ of the compound system, C, and fissioning states $|f\epsilon_f^->$ of pairs of fragments F_1 and F_2. The states $|c\epsilon_c^+>$, $|\lambda>$, and $|f\epsilon_f^->$ are conveniently defined within an extended generator-coordinate method by $|\Phi> = \Sigma_\alpha \int d\rho\, \phi_\alpha(\rho)|\alpha,\rho>$. Here, in addition to the integral over the generator coordinate(s), ρ, a sum over a limited number of adiabatic states, α, is included. The sum and integral are limited to appropriate subspaces $\{c\}$, $\{\lambda\}$, and $\{f\}$. Near or below the fission threshold the subspaces are defined as follows: $\{c\}$ includes the adiabatic states $|\alpha,\rho>$ around the ground-state deformation in the first valley with a light particle in the continuum, $\{\lambda\}$ is restricted to bound states in the first and second valley, and $\{f\}$ consists of adiabatic states beyond the second saddle point. Within this approach the threshold dependence of the fission cross section is discussed, and the model Hamiltonian for the description of gross-, intermediate-, and fine-structure resonances in the total fission cross section is obtained. Whereas in low-energy fission the dependence of the total fission cross section is mainly determined by the structure of the compound states, there are many fission phenomena (e.g. mass yields, charge and spin distributions between the fragments, total kinetic energies and excitation energies of the fragments) which are strongly influenced by the properties of the fissioning states $|f\epsilon_f^->$. If there is a specific adiabatic state populated at the (second) saddle point, the fission phenomena are mainly determined by the coupling of this specific state to other adiabatic states. This coupling is considered in the level-crossing model and found to be strong between collective states and weak between noncollective states. A useful hierarchy of the adiabatic states is introduced, which leads to the definition of fission bands. In the picture of this hierarchy, the static scission point model, the adiabatic model, the diabatic model of Kelson and Griffin, the statistical model of

Fong, and the thermodynamical model or quasi-equilibrium model are discussed. (5 figures, 1 table) (auth)

5029 SUMMARY OF THE SYMPOSIUM. Dietrich, K. (Technische Univ., Munich). pp 461-471 of Physics and Chemistry of Fission, 1973. Vol. II. Vienna; International Atomic Energy Agency (1974).

From 3rd symposium on the physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973). See STI/PUB-347 (Vol.2); CONF-730823-P2.

Progress made in the understanding of nuclear fission is summarized. In the experimental area one of the most significant discoveries was the fission isomers. Also discussed are angular distributions, masses, and kinetic energies of fragments, fragment de-excitation, variances of distribution of excitation energy, and heavy-ion reactions and fission. Progress in the theoretical area concerned potential energy, kinetic energy and dynamics, statistical theories, and coupling of external to internal degrees of freedom. Some of the most striking unresolved problems are then described. These include the following: size of the Strutinsky shell correction, the odd−even effect in the isomer and spontaneous fission half-lives, the discrepancy between empirical and theoretical E_{II} values as a function of neutron number, the Cm−Th anomaly, the fission of ^{232}Th, the very rapid increase of the cross section near threshold for symmetric fission of Ra and Ac, the problem of nuclear viscosity, and the importance of reflection symmetry and its breaking. (3 figures, 2 tables) (RWR)

5030 DETERMINATION OF NUCLEAR POTENTIALS FROM THE NONLINEAR MESON THEORY. Hwang, J. L. (National Taiwan Univ., Taipei); Wang, C. S.; Hsieh, S. M.; Chang, Z. S. Chin. J. Phys. (Taiwan); 12: No. 1, 37-47(Apr 1974).

Interpretation of the behavior of finite nuclei in terms of a nonlinear meson theory is much simpler in procedure than the many-body problem approach. The nonlinear wave equation studied independently by Schiff and Malenka is reexamined, and a systematic procedure is found to determine nuclear one-body potentials from experimental data on nucleon distributions. Originally, the theory of Schiff and Malenka involves an evitable drawback to treating a homogeneous nonlinear differential equation, which it is hopeless to solve, not only analytically, but also numerically, by a conventional approximate method. This drawback is removed by taking terms involving derivatives as perturbations instead of the conventional treatment for nonlinear terms. The solution is then obtainable by steps of iteration even with a hand computer. Two types of nucleon distribution, Fermi-type and 3-parameters-type, are used as examples to derive the nuclear potential of the $^{197}_{79}$Au nucleus. Only two steps of iteration yield satisfactory results for both cases. (3 figures, 2 tables) (auth)

5031 DWBA CALCULATION FOR MONOPOLE TRANSITIONS. Kawazoe, Y. (Tohoku Univ., Japan). Kakuriken Kenkyu Hokoku; 6: No. 2, 211-215(Dec 1973).

A DWBA code for monopole transitions was required because of the strong indication of the giant monopole resonance, and the calculation of the form factor for the two-phonon 0^+ state was required. The DWBA code DUELS was improved, and a new code was written. The Coulomb part of the DWBA differential cross section for inelastic electron scattering was written in the Coulomb gauge. The spin of the target was assumed to be zero.
An equation obtained is suitable for the following experimental conditions: (1) unpolarized electron beam and (2) detector unable to distinguish the direction of the electron spin. Then, the equation was reduced to some simple form for actual calculation. The form factor for the giant resonance in ^{90}Zr and the form factor for the two-phonon 0^+ state in ^{106}Pd were calculated by the present computer code, and the results are shown. (JA)

5032 PROBABILITY DISTRIBUTIONS FOR THE HEIGHTS OF MAXIMA AND MINIMA IN FLUCTUATING NUCLEAR CROSS SECTIONS. Branford, D. (Univ. of Edinburgh); Newton, J. O. Aust. J. Phys.; 27: No. 3, 293-299(Jun 1974).

Probability distributions for the heights of maxima and minima in fluctuating nuclear cross sections have been obtained from synthetic excitation functions. It is shown how these distributions can be used to determine the extent to which experimentally observed large excursions from the average cross sections may deviate from the predictions of simple fluctuation theory. A discussion is given of problems associated with the detection of resonance anomalies in experimental excitation functions. (auth)

5033 APPROXIMATE METHODS FOR THE CALCULATION OF RESONANCE ABSORPTION. Meyer, P. E. Ann Arbor, MI; Univ. of Michigan (1974). 264p. University Microfilms Order No. 74-25,269.

Thesis (Ph. D.).

Some approximate methods for the calculation of resonance absorption of neutrons are studied. The problem of resonance absorption is defined and then simplified, through appropriate approximations, to an inhomogeneous integral equation for the neutron flux. Approximate solutions for the resonance integral, a weighted average of the neutron flux, are sought, with the goal in mind of achieving reasonable accuracy with considerable computational savings over more rigorous methods. The method of successive approximations is extended through the use of a new trial operator. Both the successive approximations and variational methods are extended by including the interference scattering term in the Doppler-broadened resonance scattering cross section of the resonance absorber. Previous approximate methods have included either Doppler-broadened cross sections or interference scattering, but not both. In addition to these extensions, much of the previous work on approximate methods is reviewed and unified. It is found from the numerical results that interference scattering cannot always be neglected. It is concluded that the use of the new trial operator and the approximate treatment of interference scattering with Doppler broadening should be used, since both improve upon the current "state-of-the-art" for the intermediate resonance approximate methods. (RWR)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 3506, 3507, 4151, 4422, 4490, 4810, and 5066.

5034 (AERE-R-7805) CALCULATIONS OF THE DEPTH DISTRIBUTION OF ENERGY DEPOSITION BY ION BOMBARDMENT USING THE COMPUTER PROGRAM OF MANNING AND MUELLER (1973). Matthews, M. D. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Aug 1974. 41p. Dep. NTIS (US Sales Only) $5.25.

The computer program of Manning and Mueller (Computer Physics Comm.; 7:85 (1974)) to calculate the depth distribution of energy deposition by ion bombardment has been adapted to run on the Harwell central computer. This report describes the different versions of the basic program that have been written to suit the needs of Harwell users and gives sufficient detail to enable users to follow the program output and run the program from HUW terminals if required. Some typical results are included and compared with experimental data. (auth)

5035 (ARL/Met.-91) METHOD FOR THE ACCURATE DETERMINATION OF THERMAL DIFFUSE SCATTERING OF X RAYS. Towers, G. R. (Department of Supply, Melbourne (Australia)). Oct 1973. 9p. Dep. NTIS (US Sales Only) $4.00.

It is shown that x-ray intensity measurements made at three temperatures are sufficient to allow separation of the thermal diffuse scattering from the total scattered intensity in certain temperature ranges where the phonon energy is no longer given by kT. (auth)

5036 (CONF-740940-1) CALCULATIONS OF THE TRANSPORT OF FAST NEUTRONS ($\lesssim$50 MeV) THROUGH MATTER. Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn. (USA)). 1974. 51p. Dep. NTIS $5.75.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, F. R. Germany (30 Sep 1974).

The data and methods which are available to carry out coupled neutron–photon transport calculations at neutron energies $\lesssim$50 MeV are discussed. The emphasis is on those problems which involve the higher neutron energies ($\gtrsim$15 to 20 MeV) and on those problems where charged-particle spectra produced by neutron–nucleus collisions are required; and much of the discussion is centered about the code HETC, which is capable of solving such problems. Calculated results on absorbed dose, LET spectra, cell-survival probabilities, OER's, and RBE's for several neutron spectra incident on a tissue-equivalent phantom are presented, and some comparisons between calculated results and experimental data are given. A few comparisons are also given for LET spectra, OER's, and RBE's for the case of photons, neutrons, negatively charged pions, protons, and alpha particles incident on a tissue phantom. All of the cell-inactivation calculations were carried out by using the model of Katz et al. and parameters appropriate to T-1 kidney cells. (16 figures, 8 tables) (auth)

5037 (COO-1671-60) THEORY OF RBE. Progress Report, 1 January 1974–31 December 1974. Katz, R. (Nebraska Univ., Lincoln (USA)). 1974. Contract AT(11-1)-1671. 9p. Dep. NTIS $4.00.

Predictions from the Theory of RBE have been verified for dosimeters and biological systems in a range of radiation environments. Included are the response of alanine to fast neutrons, of the dye-cyanide dosimeter to 3 MeV protons, of the Fricke dosimeter to 4 GeV nitrogen ions, the survival of mammalian cells after irradiation with mixtures of neutrons and gamma-rays, beams of GeV nitrogen and oxygen ions, and spread out He beams, the RBE of spread out He beams as experienced by mouse skin. In-vitro cellular radiosensitivity parameters yield RBE-Dose relations for neutrons of different energies that are consistent with in-vivo measurements, for human and animal systems. New radiosensitivity parameters have been evaluated. A statistical procedure is being employed to find optimal values of the parameters, and to assign confidence limits from the data. Ridge filters for 3, 5, and 10 cm wide isosurvival regions for Bevalac ions have been designed. Collaborations to refine parameter assignments and identify radiation response from molecular structure have been initiated for alanine and for dye-cyanide. Cellular radiosensitivity parameters have been incorporated into Oak Ridge energy diffusion codes, for predicting biological response in neutron and pion irradiations. (auth)

5038 (LBL-3081) DIGITAL X-RADIOGRAPHY FOR MEASURING SMALL DENSITY VARIATIONS. Kaplan, S. N.; Ortendahl, D.; Perez-Mendez, V.; Shiraishi, L.; Valentine, K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 8 Jul 1974. Contract W-7405-eng-48. 8p. (CONF-741017-6). Dep. NTIS $4.00.

From meeting of the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

The possibility is discussed of distinguishing small density variations in soft tissue by using monoenergetic x-rays if digital-imaging and contrast-enhancement techniques are employed. The number of counts required to distinguish 1% thickness differences in a water absorber is shown, as a function of x-ray energy. Also shown is the average absorbed dose under these irradiation conditions. Some preliminary experimental measurements were made to confirm these calculations. (MHR)

5039 (ORNL-TM-4664) DEVELOPMENT OF A CODE SYSTEM FOR DETERMINING RADIATION PROTECTION OF ARMORED VEHICLES (THE VCS CODE). Rhoades, W. A. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 90p. Dep. NTIS $7.50.

A system of coupled computer codes is developed for the calculation of the protection from nuclear radiation provided by an armored vehicle. The code system uses a discrete-ordinates air-transport calculation coupled to an adjoint Monte Carlo calculation. The vehicle description is supplied in combinatorial geometry form. Elements of the method were tested against experimental data. A realistic tactical nuclear weapon problem is demonstrated. (auth)

5040 (SSI-1974-019) HOW THE EXPOSITION RATE DEPENDS ON THE DENSITY THICKNESS AND RADIOACTIVITY OF THE BUILDING MATERIAL. Malmqvist, L. (Statens Straalskyddsinstitut, Stockholm (Sweden)). May 1974. 29p. (In Swedish). Dep. NTIS (US Sales Only) $4.50.

The γ-radiation from walls constructed of concrete with a density of 0.5 kg/dm^3 and ordinary red bricks have been measured. It was found that the concrete gives an exposition rate which is 2.5 times higher than that for bricks. For bath materials it was found that the radiation 100 cm from the wall is ca 35% of what it is close to the wall. The difference in self absorption between bricks and concrete is shown in a diagram. (Sweden)

5041 (UCID-16522) TRANSFER CROSS SECTION MATRIX FOR ELASTIC NUCLEAR SCATTERING OF LOW Z IONS IN DEUTERIUM. Corman, E. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Mar 1974. Contract W-7405-eng-48. 17p. Dep. NTIS $4.00.

Work has been devoted to the extraction of cross sections for the elastic scattering of charged particles by the nuclear force field. This utilization of such cross sections was incorporated into some Monte Carlo codes along with the effects of the long-range Coulomb force field. Attempts are now made to include the large-angle nuclear scattering into codes that use multigroup diffusion of energetic ions slowing down in a plasma, which is considered to be predominantly deuterium. The case of the triton is emphasized. The following tables are given for protons, deuterons, tritons, and alpha particles: the angle-integrated nuclear scattering cross section plotted vs the ion energy in a deuterium plasma, the transfer cross section in barns, and a large table resulting from transfer cross section calculations repeated for different boundaries. (12 tables) (RWR)

5042 SIMPLIFIED DERIVATION OF THE POINCARÉ–BERTRAND FORMULA. Baird, L. C.; Zweifel, P. F. (Virginia Polytechnic Inst. and State Univ., Blacksburg, VA). Nucl. Sci. Eng.; 55: No. 3, 351-353(Nov 1974).

A simplified derivation of the Poincaré–Bertrand formula is presented in the form in which the formula is usually applied in transport theory calculations. It is not necessary to go to the complex plane for the analysis; instead, the integrals are reduced to tabulated form. (1 figure) (auth)

5043 SMALL-ANGLE MULTIPLE SCATTERING OF IONS IN THE SCREENED COULOMB REGION. I. Angular Distributions. Sigmund, P. (Copenhagen Univ. (Denmark). H. C. Oersted Inst.); Winterbon, K. B. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nucl. Instrum. Methods; 119: No. 3, 541-557(1 Aug 1974).

Booth's formula for the angular distribution of multiply scattered particles in the small-angle limit has been evaluated numerically for ion–atom potentials of Thomas–Fermi and Lenz–Jensen type, and analytically for power potentials. Special attention is paid to a correct transition from multiple- to single-scattering distributions at small target thicknesses. In general, good agreement is found with results of Meyer that are based on essentially the same physical model, but deviations in the distributions of up to ~40% occur. The tabulations comprise a larger range of reduced thicknesses than Meyer's, $0.001 \leq \tau \leq 2000$, with a view to both lower absolute thicknesses (e.g. a monolayer) and higher ion energies. Finally, an inversion formula for extracting single-scattering cross sections from measured multiple-scattered distributions is derived. (auth)

5044 LIFETIME OF CARBON EXCITER FOILS FOR BEAM-FOIL SPECTROSCOPY. Dobberstein, P.; Henke, L. (Freie Univ. Berlin (F. R. Germany)). Nucl. Instrum. Methods; 119: No. 3, 611-612(1 Aug 1974).

Carbon exciter foils (3 to 5 μg cm^{-2}) are bombarded with ion beams in the energy range 70 to 600 keV and Z range 1 to 54. The time until foil breakage shows a strong Z dependence, and was found to be proportional to the inverse of the nuclear stopping power. (auth)

5045 EFFECTS OF INNER SHELL EXCITATION ON THE STOPPING POWER OF SOLIDS FOR HEAVY IONS. Thompson, M. W.; Neilson, G. W. (Sussex Univ., Brighton (UK). School of Mathematical and Physical Sciences). Phys. Lett., A; 49: No. 2, 151-153(26 Aug 1974).

The range of 100 keV heavy ions in aluminium has previously been found to decrease sharply as a function of the ion's atomic number near $Z_1 = 59$. This is attributed to the excitation of inner-shell electrons in collisions where energy-level matching occurs. (auth)

5046 ATTENUATION OF LOW ENERGY ELECTRONS IN Al_2O_3 AS DETERMINED BY PHOTOELECTRON SPECTROSCOPY. Battye, F. L.; Liesegang, J.; Leckey, R. C. G.; Jenkin, J. G. (La Trobe Univ., Bundoora (Australia). Dept. of Physics). Phys. Lett., A; 49: No. 2, 155-156(26 Aug 1974).

New photoelectron measurements of the attenuation length are reported for low energy electrons by a method in which the attenuation of photoelectrons from a substrate is monitored as a function of the thickness of an overlayer of Al_2O_3, which is essentially transparent to the x-radiation used to generate the photoelectrons in the substrate. The attenuation length of electrons in Al_2O_3 has been determined to vary from 6.7 Å at 157 eV to 16.7 Å at 1404 eV. (auth)

5047 A METHOD FOR ENERGY-LOSS AND RANGE CALCULATIONS BASED ON EMPIRICAL APPROXIMATIONS. Zaidins, C. S. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). Nucl. Instrum. Methods; 120: No. 1, 125-129(15 Aug 1974).

An empirical approximation for both the stopping power, $dE/d(\rho\chi)$, and the range, R, which are functions of the energy E, have been suggested. These expressions are for use in the non-relativistic energy region and contain two parameters, C and α, which depend upon the projectile and target material. A program for calculating energy losses and tables of the parameters for light projectiles are presented. (auth)

5048 AN IMPROVED METHOD FOR THE DETERMINATION OF THE MAXIMUM ENERGY OF DISTORTED β-SPECTRA AND THE IN-DEPTH LOCALIZATION OF SPATIALLY DISTRIBUTED β-EMITTING ISOTOPES. van de Geijn, S. C. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen (Netherlands)). Nucl. Instrum. Methods; 120: No. 1, 107-112(15 Aug 1974).

The linearity of the Kurie plot of beta spectra from thick and non-uniform sources embedded in unlabelled material can significantly be improved using a modification of the Kurie-transformation similar to that following from the theory proposed by Konopinski and Uhlenbeck. This approach facilitates the maximum-energy determination of β-spectra from internal sources, as present e.g. in living biological material in tracer experiments. The reduction of the maximum energy, which is representative for the thickness of the non-labelled material covering the source, can be determined with an accuracy which depends on the maximum energy of the β-radiation. For ^{14}C, ^{45}Ca and ^{32}P the accuracy is equivalent to respectively 20, 25 and 40 μm at a density of 1 g/cm^3 and is apparently almost independent of the actual spatial distribution. The method described here is far more general than the original one, and may be used also in beta spectrometry for the endpoint determination of spectra from low-specific-activity sources. (auth)

5049 EFFECT OF MULTIPLE SCATTERING ON EXPERIMENTAL COMPTON PROFILES: A MONTE CARLO CALCULATION. Felsteiner, J.; Pattison, P.; Cooper, M. (Univ. of Warwick, Coventry, Eng.). Phil. Mag.; 30: No. 3, 537-548(Sep 1974).

A Monte Carlo technique is used to calculate the total intensity and spectral distribution of multiple-scattered photons in a typical γ-ray Compton scattering experiment. The method can be used to correct experimental Compton profiles for the effect of multiple scattering. The procedure is applied to two profiles of water measured on samples of different thicknesses, and the resultant corrected profiles are seen to be independent of the original sample thickness; furthermore, their agreement with a recent calculation using a near Hartree–Fock wave function is significantly improved. (auth)

5050 SHIELDING CALCULATION FOR A DOUBLY BENT DUCT IN A CONCRETE SLAB SHIELD FOR GAMMA RADIATION. Yamaji, A. (Ship Research Inst., Tokai, Japan); Fiebig, R. Senpaku Gijutsu Kenkyujo Hokoku; 11: No. 3, 127-137(May 1974). (In Japanese).

Shielding calculations are made to obtain a standard of the effective shield design for a concrete slab shield with a doubly bent duct for gamma radiation. In order to have the same shield effect behind the shielding wall with the duct as the one without the duct, slabs of iron or lead are inserted in the wall to attenuate the gamma-ray leakage. Calculations were made with the ray analysis method for determination of the lengths, widths and heights of the additional slab shields. (auth)

5051 CHARACTERISTIC ELECTRON ENERGY LOSSES IN METALLIC ALLOYS AND THEIR COMPONENTS. Arifov, U. A.; Aliev, A. A.; Shadikhodzhaev, I. S. (Inst. of Electronics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 5, 17-19(1974). (In Russian).

The behavior of alloy constituents at high temperatures over a considerable time is a complicated process depending on the nature and structure of individual alloy components. Under these conditions it is possible to change the alloy composition in the surface layer, determining its emission characteristics compared with the composition in the body of the emitter. A study of characteristic energy losses (CEL) of electrons in the alloys shows that one of the methods sensitive to the state of the surface layer of the solid body having a thickness of a few atomic layers is an analysis of the energy spectra of electrons scattered by the sample surface as a function of temperature. At high energy resolution of the energy-analyzer in the high-energy region of the spectrum the CEL peaks up to ~50 eV are of greatest interest in studying the state of the surface layer. These peaks were found to lie at 12, 25 and 47 eV for the element Mo, at 11, 17 and 56 eV for the element Nb, at 20, 36 and 47 eV for the element Ti, at 23 and 51 eV for the alloy Mo + 65% Nb, and at 18, 45, 78 for the alloy Mo + 40% Ti. Selective evaporation of molybdenum was detected in the Mo + 65% Nb alloy, and of titanium in the Mo + 40% Ti alloy with depletion of both these elements in the surface layers. (SJR)

5052 MEASURED AND CALCULATED DOSE DISTRIBUTIONS FROM NEUTRONS INCIDENT ON A TISSUE-EQUIVALENT PHANTOM. Hubbell, H. H. Jr.; Chen, W. L.; Shinpaugh, W. H.; Jones, T. D. (Oak Ridge National Lab., TN). Health Phys.; 27: No. 3, 289-297(Sep 1974).

Doses from recoil ions and from neutron-produced γ rays were measured separately as functions of depth in a tissue-equivalent phantom having a diameter of 30 cm and a height of 60 cm. Sources of fast neutrons were the Health Physics Research Reactor (a bare unmoderated reactor) and D-T neutrons produced by a small accelerator. Effects of scattered neutrons and γ rays and of γ rays incident from the core of the reactor were subtracted from measured distributions by using simultaneous measurements in an identical phantom shielded by a shadow shield, and by blank runs with the phantom tanks empty. The shadow shield was filled with borax and paraffin, and the ends were covered by lead. The system used to measure recoil ion doses was insensitive to γ rays and consisted of a small Hurst-type polyethylene wall, cyclopropane-filled proportional counter coupled to a Radsan dose integrator. Gamma ray doses were measured by a small Philips GM counter practically insensitive to neutrons. Both systems of detection were calibrated frequently with standardized radiation sources. Results compared well on an absolute basis with Monte Carlo calculations for a broad beam of neutrons having a similar spectral distribution unilaterally incident on a cylindrical tissue-equivalent phantom of the same dimensions. (auth)

5053 ANALYTICAL EXPRESSION FOR THE NEUTRON FLUX-TO-DOSE CONVERSION FACTORS. Rindi, A. (Univ. of California, Berkeley). Health Phys.; 27: No. 3, 322-323(Sep 1974).

An analytical expression for the flux-to-dose conversion factor for use in calculations of the dose equivalent rates in mixed neutron fields is given which fits the ICRP (1973) recommendations. Comparative values are given of the conversion factor as calculated by the proposed expression and as tabulated by ICRP. The errors are within +8.3% and −4.2%. Attention is drawn to similar values calculated for the dose equivalent from a neutron source of the 1/E type covering 10 energy decades. (UK)

5054 ABSORPTION OF 5.47 MeV ALPHA PARTICLES BY MEMBRANE FILTER MATERIAL. Jonassen, N.; Hayes, E. I. (Danmarks Tekniske Hoejskole, Lyngby). Health Phys.; 27: No. 3, 313-316(Sep 1974).

Membrane filters are used to collect samples when measuring airborne concentrations of the ^{222}Rn short-lived daughters ^{218}Po, ^{214}Pb, ^{241}Bi and ^{214}Po. These samples are suitable for analysis by α spectroscopy. However the α particles which originate in the decay of ^{218}Po and ^{214}Po lodged below the filter surface lose an amount of energy corresponding to the path travelled through the filter. The path length travelled in the filter may be calculated if the specific energy loss of the α's in the filter material is known. An investigation of the range and energy loss in Millipore type AA filter material of 5.47 MeV α particles was carried out and the results are reported. The results obtained give a good approximation to the absorption for the 6.0 MeV α's from ^{218}Po (half-life 3.05 min) and although too low for the 7.68 MeV α's from ^{214}Po (half-life 1.6×10^{-4}sec) are still a useful approximation. (UK)

5055 THEORY OF CHANNELING EFFECT. III. Fast Particle Energy Losses. Kagan, Yu.; Kononets, Yu. V. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1693-1711(May 1974). (In Russian).

The formalism developed previously is employed for analyzing the energy losses of fast charged particles traversing crystals under channeling conditions. The problem is reduced to that of solving a Fokker-Planck type equation in transverse momentum and transferred energy space. An analysis of the stopping power and energy straggling coefficient shows that in the case of deep below-the-barrier states these quantities are mainly determined by scattering by valence electrons. In contrast, for low above-the-barrier states both quantities appreciably exceed the corresponding values in a random medium. It is shown that to a large extent the shape of the energy distribution is determined by the character of diffusion escape of particles from the channel. In the case of planar channeling the solution obtained reproduces in all details the energy distribution of particles hitherto observed experimentally. (auth)

5056 RECIPROCITY PRINCIPLE FOR SCATTERING OF FAST CHARGED PARTICLES BY CRYSTALS. Beloshitskii, V. V.; Kumakhov, M. A. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1783-1789(May 1974). (In Russian).

Macroscopic reversibility of the Fokker-Planck equation for charged particles scattered by a crystal is proven by neglecting energy losses. It is demonstrated that due to variation of the particle transverse energy induced by ionization losses, reversibility is violated at small depths. The problem of multiple scattering of particles emitted from a crystal lattice site or from a point close to the latter is solved. It is shown that a detailed account of multiple scattering must be made if information regarding the localization of the emitting nucleus is required. The theoretical and experimental results are compared. (auth)

5057 BUILDUP FACTORS OF SCATTERED γ-RADIATION FROM A POINT SOURCE IN AN UNBOUNDED AIR MEDIUM. Vrubel, M. N.; Sidneva, S. N.; Strelkov, A. S. Sov. At. Energy (Engl. Transl.); 34: No. 1, 63-65(Jan 1973).

Translated from At. Energ. (USSR); 34: No. 1, 47-49(Jan 1973).

The nonstationary problem of propagation of γ-radiation from a prompt point isotropic monoenergetic source through a homogeneous air medium is solved by the Monte Carlo method. (MHR)

5058 RADIOISOTOPE AND RADIATION PHYSICS. An Introduction. Mladjenovic, M. New York; Academic Press, Inc. (1973). 250p. $19.00.

Translated by Sonja Subotic.

The nature of matter, radioactivity, and charged particles is described, with emphasis on the phenomena involved in collisions between particles and atomic systems. This background is then used to discuss in some detail the penetration of alpha, beta, and gamma radiation. Some of the topics discussed are stopping power, bremsstrahlung, scattering, the photoelectric effect, the Compton effect, and pair production. (MHR)

5059 DETERMINATION OF TOTAL CROSS SECTIONS OF THE RADIATION LOSSES OF ELECTRONS. Dmitrov, G. N. Sov. At. Energy (Engl. Transl.); 35: No. 1, 665-666(Jul 1973).

Translated from At. Energ. (USSR); 35: No. 1, 50(Jul 1973). This is a summary of paper No. 677/7111 with full copy held at TIC.

In order to calculate the total cross sections of radiation losses of electrons, an empirical formula was obtained for the dependence of the total cross section of radiation losses of electrons on the energy of the incident electrons and the charge of the damping medium. (MHR)

5060 EFFECT OF A PLANE BOUNDARY ON THE β-RADIATION DOSE DISTRIBUTION INSIDE A THICK-LAYERED SOURCE. Osanov, D. P.; Podsevalov, Yu. N. Sov. At. Energy (Engl. Transl.); 35: No. 1, 664-665(Jul 1973).

Translated from At. Energ. (USSR); 35: No. 1, 49-50(Jul 1973). This is a summary of paper No. 676/7107 with full copy held at TIC.

A calculation is carried out for the dose distribution inside and on the surface of a thick-layered plane tissue-equivalent source with given one-dimensional distribution of concentration of radioactive substance A(x)-powers, exponentials, etc. The effect the presence of boundaries has on the increase of the dose at the points C_1 and C_2 located to the right and to the left of an elementary infinitesimally thin source is considered. (MHR)

5061 INVARIANT IMBEDDING THEORY OF NUCLEAR TRANSPORT. Mingle, J. O. Modern Analytic and Computational Methods in Science and Mathematics, No. 39. New York; American Elsevier Publishing Company, Inc. (1973). 141p.

The following topics are covered: introduction to transport theory, basic invariant imbedding concepts, albedo theory: functional form, scattering matrix concepts, albedo theory: discrete form, transmission theory, escape function concepts, the monoenergetic case, extensions to multiparticle theory, the special case of photon transport, curved geometry considerations, and numerical analysis considerations. (MHR)

Radiation Protection Standards

Refer also to abstract 3315.

5062 (AED-CONF-74-140-009) DEVELOPMENTAL TENDENCIES IN RADIATION PROTECTION STANDARDS AS SEEN FROM THE MEDICAL POINT OF VIEW. Mehl, J. (Bundesministerium des Innern, Bonn (F.R. Germany)). 1974. 16p. (In German). INIS.

From German x-ray congress; Baden-Baden, F.R. Germany (25 Apr 1974).

31 refs.

The state of the art in the field of radiation and environmental protection standards and units on a national as well as international level is surveyed. (GE)

5063 (COO-1764-212) VARIATIONAL METHOD FOR SOLENOIDAL EXCITATION OF YANG–MILLS FIELD. Suura, H. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 16 Jul 1974. Contract AT(11-1)-1764. 27p. Dep. NTIS $4.50.

A vortex-like excitation mode of the massless Yang–Mills field coupled to fixed classical I-spin sources is investigated by the variational method. The lattice point quantization is introduced as an intermediate step to evaluate the variational integral of the field Hamiltonian. The method leads to the Ginzburg-Landau equations without the mass term. Some aspects of the model, especially the shielding of the Coulomb interaction by induced I-spin density, are discussed from the point of possible applications to the model of hadrons. (auth)

5064 RADIOLOGICAL SAFETY. Martin, A. (Associated Nuclear Services, London). Nucl. Eng. Int.; 19: No. 220, 746-748 (Sep 1974).

A report is presented of a seminar on radiological safety, entitled "Evaluation of population doses and application of radiological safety standards to man and the environment," held at Portoroz, Yugoslavia in May. The main topics discussed were safety standards and their basis, the place of cost–benefit analysis in setting these standards, and the estimation of population dose. (auth)

5065 ASPECTS OF FRENCH REGULATIONS GOVERNING PROTECTION AGAINST RADIOACTIVITY. Bresson, G. (CEN, Fontenay-aux-Roses, France). Radiol. Prot. Bull.; No. 8, 4-7(Jul 1974).

The French regulations in the field of radiological protection are reviewed. Individual laws and their applications are discussed for the licensing of industrial and commercial establishments preparing, using or storing radioactive substances, the installation and operation of nuclear reactors and accelerators, and the manufacture and use of medical and industrial radioisotopes. Regulations governing the protection of workers against ionising radiations, as well as the protection of the public and the environment, are also considered. (UK)

Radiation Source Calibration and Standardization

5066 DOSE-RATE TABLES FOR CLINICAL ^{137}Cs SOURCES SHEATHED IN PLATINUM. Breitman, K. E. (Manitoba Cancer

Treatment and Research Foundation, Winnipeg). Brit. J. Radiol.; 47: No. 562, 657-664(Oct 1974).

Dose tables and isodose curves for several commercially available platinum-filtered cesium-137 tubes and needles are presented and shown to be more closely related to those of radium sources than to stainless steel-filtered ^{137}Cs sources. Alternative definitions of the concept of exposure equivalent milligrams of radium as a method of specifying the activity of ^{137}Cs sources are discussed. An activity correction factor characteristic of each source was introduced as a function of the active length and the source filter material and thickness. Application of this factor facilitated conversion to millicuries from units of milligrams of radium equivalent when the latter unit was based on the equivalence of the exposure dose rates, in air at 25 cm distance, of the cesium source and a point source of radium screened by 0.5 mm platinum. (auth)

5067 STANDARDIZATION OF ^{60}Co AND ^{137}Cs GAMMA-RAY BEAMS IN TERMS OF EXPOSURE. Loftus, T. P.; Weaver, J. T. (National Bureau of Standards, Washington, DC). J. Res. Nat. Bur. Stand.; 78A: No. 4, 465-476(1974).

At the National Bureau of Standards (NBS), the exposure-rate standards for ^{60}Co and ^{137}Cs gamma rays were based for a number of years on a weighted average of measurements using a cylindrical ionization chamber and a group of small spherical chambers. Complex setup conditions for the cylindrical chamber, differences between the cylindrical and spherical chamber data, and recognition that the institution of this weighted average exposure-rate standard increased the difference between free-air-chamber and cavity-chamber measurements, led to the development of new spherical chambers. All correction factors for exposure-rate measurements were investigated and updated. Excellent agreement was achieved between independent exposure-rate measurements for six spherical chambers and, as of May 1, 1972, the exposure standards were reduced 0.7 percent for ^{60}Co and 0.6 percent for ^{137}Cs gamma rays. Recalculation of correction factors since that time indicates that the standard ^{137}Cs should be further reduced by 0.2 percent, and this adjustment was made on July 1, 1974. The uncertainties associated with each of the quantities entering into the determination of exposure rate were tabulated and the overall uncertainty of the exposure rates used for instrument calibrations at NBS was found to be about 0.7 percent for addition in quadrature. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 5216–5218.

5068 (EUR-5159e) SABINE-3: AN IMPROVED VERSION OF THE SHIELDING CODE SABINE. Ponti, C.; Van Heusden, R. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). 1974. 17p. Dep. NTIS (US Sales Only) $4.00. EUR B.Fr.25.-.

The new version of the program SABINE, for one-dimensional bulk shielding calculations, is described. The main improvements implemented into SABINE-3 are: the complete test of input data before starting the execution of a problem; a more accurate and flexible calculation of gamma-ray fluxes, that allows to save computer time; and an up-dated library that includes also data for gamma-rays arising from neutron inelastic scattering. (auth)

5069 (KR-150) 05R MONTE CARLO CALCULATIONS OF FAST NEUTRON REFLECTION FROM PLANE AND CURVED CONCRETE SHIELDS. Sayedahmed, F.; Tveten, U. (Institutt for Atomenergi, Kjeller (Norway)). Jun 1974. 34p. Dep. NTIS (US Sales Only) $4.75.

Radiation streaming is one of the important shielding problems for which there is still no adequate method of solution. Both numerical and analytical methods are available, but they are either of unsatisfactory accuracy or too cumbersome. In recent computer programs attempts have been made at combining the two, usually in a combination of Monte Carlo and albedo methods. The most frequently encountered type of streaming problem is streaming along a cylindrical duct. One weakness of such a combination as used at present is that the albedoes used are valid for flat walls, while the reflector wall in question is in fact curved. A series of calculations is presented with the main purpose of comparing albedoes from curved and flat surfaces, for various initial neutron energies and angles for incidence. Analytical expressions for the dependence upon curvature, energy and angle of incidence are also presented. It is concluded that when a flat wall albedo is used in duct penetration calculations, the error introduced may often be appreciable. Neglect of the curvature effect will lead to an overestimate of the reflection, while use of albedo for improper angle of incidence gives an additional error; usually an underestimate. (auth)

5070 γ-RAY BUILDUP FACTORS FOR CYLINDRICAL SHIELDING BLOCKS. Broder, D. L.; Kozlovskii, S. A.; Kulikov, V. I.; Kuchin, N. L.; Popkov, K. K.; Trofimov, I. N. Sov. At. Energy (Engl. Transl.); 35: No. 6, 1143-1144(Dec 1973).

Translated from At. Energy. (USSR); 35: No. 6, 438-439(Dec 1973).

An attempt was made to obtain values for γ-ray dose buildup factors in the energy range from 0.5 to 8 MeV for long cylindrical shielding blocks. Monte Carlo calculations were performed. The program was checked by several calculations of energy and spatial distributions of gamma fluxes from sources in homogeneous media. Calculations of buildup factors in cylindrical shielding blocks were performed for the case where a point isotropic monoenergetic source of γ rays was located in the end plane of the block on the symmetry axis. Analysis of the results led to an empirical expression for the γ-ray buildup factors. Calculations are shown for cylinders of lead, aluminum, and iron. (3 figures) (RWR)

5071 ANGULAR DISTRIBUTIONS OF NEUTRONS BEHIND AN IRON SHIELD. Kiryushin, A. I.; Sukharev, Yu. P. Sov. At. Energy (Engl. Transl.); 34: No. 5, 479(May 1973).

Translated from At. Energ. (USSR); 34: No. 5, 393(May 1973). This is a summary of paper No. 666/6391 with full copy held at TIC.

The Monte Carlo method was used to calculate the angular distribution behind an iron shield of fast and intermediate neutrons from an infinite plane source of fission neutrons. Angular distributions of fast ($E > 1.0$ MeV) and intermediate (0.1 MeV $\leq E \leq 1.0$ MeV) neutrons were calculated for shield thicknesses of 0.5, 1, 5, 10, 20, 30, and 40 cm for isotropic, cosine, and monodirectional sources of fission neutrons. The results show that the angular distribution of the neutron flux behind thin shields (<5 cm) results from unscattered and singly scattered neutrons. (MHR)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 4785 and 5477.

5072 (JINR-P11-8145) FAST METHOD FOR GENERATING THE RANDOM SEQUENCE WITH POISSON DISTRIBUTION. Ososkov, G. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 9p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A fast method is considered for random numbers with the Poisson distribution generating based on counting of random number of some product terms. (auth)

5073 (LYCEN-7368) EASY MANIPULATION OF THE GRAPHICAL METHOD. Elbaz, E. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire). Oct 1973. 12p. (In French). Dep. NTIS (US Sales Only) $4.00.

The graphical method is an excellent tool for treating the algebra of angular momenta in quantum mechanics (Racah algebra). The rules for applying this method are given together with some typical examples illustrating how the method can be used to solve some of the most difficult problems. The basic diagrams are grouped together. The way in which this tool can be used is described in terms of all the transformations it allows. Some typical classical examples are given which confirm the usefulness of this tool. (auth)

5074 (ORNL-tr-2877) EXPANSION BY FUNCTIONS FOR SOLVING DISPERSION PROBLEMS. Povzner, A. Ya. Translated by M. Gerrard from Dokl. Akad. Nauk SSSR; 104: No. 3, 360-363 (1955). 8p. Dep. NTIS $4.00.

The Schroedinger operator Lu is examined in the three-dimensional space E. The purpose is the construction of the spectral function of the operator L according to the function A and the establishment of formulas for conversion, in which the function A plays the same role of plane waves in the theory of the three-dimensional Fourier integral. (JFP)

5075 INFINITE DIVISIBILITY AND CRITICAL PHENOMENA. Kumar, N. (International Centre for Theoretical Physics, Trieste, Italy); Kumar, A. A. Lett. Nuovo Cim.; 11: No. 1, 39-43(7 Sep 1974).

It is argued that the divergence of the order —order correlation length and hence the irrelevance of the microscopic scales of length obtained in the critical limit should imply infinite divisibility and stability of an effective density-of-states distribution corresponding to an effective interaction Hamiltonian that describes deviation from criticality. This in turn implies a unique limiting form for the singular part of the free energy, related simply to the characteristic of the distribution. The latter shows the algebraic as well as the logarithmic branch-point singularity of the specific heat explicitly depending on the value of a certain parameter. Also the strong scaling law is shown to follow in a natural way by counting the effective number of degrees of freedom. (JFP)

5076 EIGENVALUES OF κp^{2M} ANHARMONIC OSCILLATOR. Maduemezia, A. (Ibadan Univ., Nigeria). J. Phys., A (London); 7: No. 13, 1520-1526(1 Sep 1974).

The first four energy levels of the anharmonic oscillator $H = p^2 + q^2 - \kappa p^{2M}$ are numerically evaluated for the M values 2, 3, 4, up to the tenth order of perturbation theory, and for $M = 1$, for all orders of perturbation theory. A recursion formula derived in a recent paper of the author (Maduemezia. J. Phys. A. Math. Nucl. Gen.; 6: 778-82 (1973)) on applications of hypervirial and Hellmann–Feynman theorems is used. The results indicate that for $M > 1$, the perturbation expansion in κ is divergent. The ratios of absolute values of successive terms of the perturbation series form a monotonically increasing sequence, in agreement with an earlier result of Bender and Wu (Phys. Rev.; 184: 1231-60 (1969)). The rate of divergence of this sequence of ratios is small. Furthermore, for $\kappa = 10^{-3}$, the individual values of the ratios are small—less than 10^{-4}. Thus, for sufficiently small κ values, and for the purpose of practical calculations, the energy expansion in κ effectively behaves like a convergent series up to very high orders of perturbation theory. The case $M = 1$ reduces to a harmonic oscillator. The perturbation series for this case converges to the exact solution, $(2N + 1)(1 - \kappa)^{1/2}$, for the state N. (auth)

5077 QUANTUM MECHANICS OF THE IDEAL ASYMMETRIC TOP WITH SPIN. Dowker, J. S.; Pettengill, D. F. (Univ. of Manchester, Eng.). J. Phys., A (London); 7: No. 13, 1527-1536 (1 Sep 1974).

The body-fixed symmetry of the ideal asymmetric top is that of the double four (or quaternion) group. For integral spin this is equivalent to the ordinary four-group, and the secular determinant breaks down diagonally into four distinct blocks, as in the standard theory. For half-odd-integral spin, however, two equivalent blocks are obtained, the levels being doubly degenerate. A generalization is then presented which entails making the top wavefunction a spinor-valued quantity. This is expanded in spinor hyperspherical harmonics which are generalizations of the ordinary hyperspherical harmonics, the D^{L}_{MN}. A systematic procedure is given for finding the elements of the secular determinant. The motivation for the generalization is that of spinor fields in a frozen Mixmaster universe. (auth)

5078 EVOLUTION OF WAVE PACKETS FOR PARTICLES IN CENTRAL POTENTIALS. Eswaran, K.; Mathews, P. M. (Univ. of Madras). J. Phys., A (London); 7: No. 13, 1547-1556 (1 Sep 1974).

The manner in which the extension of a small wave packet moving in a circular orbit in a central potential V(r) changes with time is examined. It is shown that, in general, the extension in the orbital plane increases indefinitely at large times unless $rV'' - V' = 0$ at the radius of the orbit. The question whether there exist any special "coherent" wave packets which retain a finite size for arbitrary times in a Coulomb potential is investigated, and the answer is shown to be in the negative. (auth)

5079 DEGENERACY IN THE PARTICLE-IN-A-BOX PROBLEMS. Shaw, G. B. (Oxford Univ.). J. Phys., A (London); 7: No. 13, 1537-1546(1 Sep 1974).

The notions of systematic and accidental degeneracy are discussed for a quantum-mechanical particle in a two-dimensional box. Separability of coordinates is shown to admit extra systematic degeneracy over that expected from the point-group symmetry. The "accidental" degeneracy for square and triangular boxes is discussed in detail and related to geometric symmetries—described by rings of operators, however, and not by a symmetry group. (auth)

5080 WAVE ENERGY TRANSFER IN TIME-DEPENDENT NONLINEAR WAVE–WAVE INTERACTIONS. Wang, P. K. C. (Univ. of California, Los Angeles). Nuovo Cim.; 24B: No. 1, 63-77(11 Nov 1974).

The wave energy transfer in a system of three nonlinearly interacting waves with well defined phases and time-dependent complex wave frequencies and coupling coefficients is studied. Necessary and sufficient conditions for the unidirectional transfer of wave energy and their relation to instability are established. Also, sufficient conditions for the nonexistence of explosive instabilities are derived. Finally, results are obtained for the special case where one of the waves is intense and the wave frequencies and coupling coefficients fluctuate with time about their mean values. (auth)

5081 LIMITATIONS AND VALIDITY OF THE HARTREE–FOCK METHOD. Pietronero, L. (Univ., Rome); Zirilli, F. Nuovo Cim.; 24B: No. 1, 57-62(11 Nov 1974).

The problem of existence and uniqueness of solutions of the Hartree–Fock equations is studied by means of the Lyusternik-Schrinlmann category theory. In the case of a box with all the states with negative energies the existence and uniqueness of the solutions are discussed. (auth)

5082 EXCITATIONS OF A NONSTATIONARY ASYMMETRICAL SINGULAR OSCILLATOR. Dodonov, V. V.; Malkin, I. A.; Man'ko, V. I. (Lebedev Inst. of Physics, Moscow). Nuovo Cim.; 24B: No. 1, 46-56(11 Nov 1974).

The Schroedinger equation with a new nonstationary potential of the type $\frac{1}{2}\omega^2(t)\, r^2 + f\,(\theta,\varphi)\, r^{-2}$ is solved exactly. Normalized solutions and transition amplitudes between energy eigenstates are expressed in terms of Jacobi and Laguerre polynomials. Integrals of the motion are considered. (auth)

5083 ADDITIONAL INVARIANCE OF THE DIRAC AND MAXWELL EQUATIONS. Fushchich, V. I. (Inst. of Mathematics, Kiev). Lett. Nuovo Cim.; 11: No. 10, 508-512(9 Nov 1974).

It is shown that there exists a new set of operators different from the operators which satisfy the Lie algebra of the Poincare group with respect to which the Dirac and Maxwell equations are invariant. Detained proof is given of the assertions only for the Dirac equation, since for the Maxwell equations all the assertions are proved analogously. (JFP)

5084 EFFECTIVE PAIR POTENTIALS FOR THE NONINTERACTING SPIN–1/2 FERMI GAS. Stevens, F.A. Jr.; Pokrant, M.A. (Department of Physics and Astronomy, University of Florida, Gainesville, Florida 32611). J. Chem. Phys. 61: No. 9, 3768-3776 (1 Nov 1974).

The N–particle configurational probability density $P^{(N)}$ of a noninteracting Fermi gas may be approximated as $P^{(N)} \simeq \Pi_{i<j} e^{-u(r_{ij})} / \int d^{3N} r \Pi_{i<j} e^{-u(r_{ij})}$, where u(r) is an effective pair potential. Our reason for considering these potentials is that they have been successfully used in computing properties of interacting Fermi systems. We define the best effective potential to be the one whose corresponding two–body distribution function is closest to the exact two–body distribution function. A method for calculating the best u(r) is not known. Lado has calculated u(r) by using the Born–Green–Yvon integrodifferential equation relating u(r) to the two– and three–body distribution functions. Effective potentials may also be calculated using the hypernetted chain and Percus–Yevick integral equations. It is found that potentials computed by the above three methods are in fairly close agreement. The principal purpose of this paper is to present tables of effective potentials approximating both the spin–summed system and parallel spin subsystem probability densities for a system of noninteracting spin–1/2 fermions. (auth)

5085 THE ELECTROMAGNETIC TWO-BODY PROBLEM IN SPECIAL RELATIVITY. Persides, S.; Pascalis, J. (University of Thessaloniki, Thessaloniki, Greece). Ann. Phys. (N.Y.) 87: No. 1, 161-175 (Sept 1974).

A system of two point charged particles is considered. Each particle moves in the electromagnetic field created by the other particle according Maxwell's equations. A scheme of successive approximations is developed to study the field and the motion of the charges. The field (potentials and intensities) are expanded in powers of c^{-1} using a retarded time coordinate. The variables of the motion (position vectors, velocities, etc) are expanded in powers of c^{-1} with coefficients depending on t only. The field is evaluated in the first three approximations. The equations of motion are derived in the same approximations and the corresponding conserved quantities are explicitly given. Thus, the usual assumption of an action–at–a–distance principle is avoided and the original nonlinear integrodifferential equations are reduced to a sequence of linear equations. (auth)

5086 PROPERTIES OF COHERENT STATES. Gilmore, R. (Univ. of South Florida, Tampa). Rev. Mex. Fis.; 23: No. 1-2, 143-187(1974).

Coherent states are obtained by applying a dynamical unitary transformation to an extremal state in an invariant subspace of a quantum mechanical Hamiltonian. The properties of coherent states are completely characterized mathematically. In addition, the following very useful theorem is proven: A physical system initially in a coherent state, or in particular in its ground state, will evolve into a coherent state. Various examples of the utility of coherent states are given. (auth)

5087 KETS OF BROKEN SYMMETRY IN THE DERIVATION OF MODEL HAMILTONIANS. Klein, D. J. (Univ. of Texas, Austin). Rev. Mex. Fis.; 23: No. 1-2, 243-256(1974).

Model Hamiltonians are often defined on a space providing a simple zero-order picture of the system under investigation. While the simplest basis kets of this zero-order eigenspace may be of broken symmetry with respect to the full group of the perturbed Hamiltonian, the basis kets often may be transformed into one another by the action of appropriate group elements. In such a case a variational development of the model Hamiltonian is described. This scheme is based primarily on a single basis ket of broken symmetry; the scheme provides an alternate to the usual perturbative development and is, in principle, exact. Particular reference to the Heisenberg exchange Hamiltonian is made. (auth)

5088 CONNECTION BETWEEN CONSTANTS OF THE MOTION OF DIFFERENT QUANTAL SYSTEMS. Anderson, R. L.; Shibuya, T.; Wulfman, C. E. (Univ. of the Pacific, Stockton, CA). Rev. Mex. Fis.; 23: No. 1-2, 257-272(1974).

Quantum mechanical constants of the motion, Q, are defined as local invariants of a quantal equation of motion. They are inherently more general objects than the invariants envisaged in the Lie-Ovsjannikov theory of the symmetry of differential equations. It is shown that for a large and important class of Schroedinger Hamiltonians H_0 and $H(\lambda)$, λ a parameter, there is a continuous one to one correspondence between the constants of the motion Q_{i0} and $Q_i(\lambda)$ for all finite times. The quantal analog of the discontinuities that Poincaré found in classical first integrals of the n-body problem are isolated and obviated. The concepts of "approximate constant of the motion" and "approximate invariant of a Schroedinger equation" can thus be usefully defined, and the algebraic properties of perturbed systems related to those of the unperturbed system. (auth)

5089 FIELDS OF FORCE: THE DEVELOPMENT OF A WORLD VIEW FROM FARADAY TO EINSTEIN. Berkson, W. London; Routledge and Kegan Paul (1974). 383p.

An historical account is given of the development of field theory. Newton's theories are contrasted with later anti-Newtonian metaphysics. The author states that his criterion for the selection of particular problems and theories as interesting ones was: which theories and scientific problems were attempts to find the true metaphysics? Successive chapters review the contributions of Faraday, Maxwell, Hertz, Lorentz and Einstein, and of other workers in the field. The chapters on Faraday include considerable extracts from his "Experimental Researches in Electricity." (UK)

5090 HOW TO MEASURE THE SPINOR CHARACTER OF FERMIONS. Drope, E. (Koeln Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Naturforsch., a; 29: No. 8, 1117-1120(Aug 1974).

A spinor is a geometrical object which changes its sign under a 2 π-rotation. As fermions are described by spinors the question arises if spinors are mere mathematical tools or if they have physical reality. We propose an experiment from which the spinor character of fermions can directly be read. We take this opportunity to put the Stern-Gerlach experiment into the language of the quantum theoretical measuring process. (auth)

5091 FINITE GROUPS AND QUANTUM THEORY. Chesnut, D. B. New York; John Wiley and Sons, Inc. (1974). 263p. $14.95.

The topics discussed are sets, groups, the partitioning and factoring of groups, mapping and groups, permutation groups, review of vector, matrices, and transformations, representations and their construction, irreducible representations, the character, the transformation of functions and coordinates, projection operators and symmetry adapted functions, group theory and quantum mechanics, matrix elements and symmetry considerations, the permutation symmetry of wave functions, and orbital approaches to chemical bonding. (JFP)

5092 INTRODUCTION TO THE QUANTUM THEORY. Second Edition. Park, D. International Series in Pure and Applied Physics. New York; McGraw-Hill Book Company (1974). 680p. $16.95.

The theoretical topics include the inadequacy of classical physics, the physical content of the wave function, general principles, systems in one dimension, hermitian operators, symmetry, and angular momentum, spin and isospin, systems in two and three dimensions, approximate methods of calculation, the theory of scattering, electromagnetic radiation, and systems containing identical particles. Applications are given covering the theory of alpha decay, electrons in a periodic lattice, the hydrogen and helium atoms, interatomic forces, the quark model of baryons, the neutron–proton interaction, thermodynamics, and statistical quantum mechanics. (JFP)

5093 CORRECTION FOR THE UNIFORM WKB WAVE FUNCTIONS AND THE WKB PHASE SHIFTS. Eu, B. C.; Guerin, H. G. (McGill Univ., Montreal). Can. J. Phys.; 52: No. 18, 1805-1815(15 Sep 1974).

A method of improving the uniform WKB solution for single turning point problems is discussed and the correction formulas for the WKB phase shifts are obtained. The method involves the equation of motion which is in a form similar to that used by Fröman and Fröman to obtain the connection formulas in the WKB approximation. A sequence of solutions to the equation of motion is obtained in a remarkably compact form—and in a novel way—by utilizing the involutionality of certain 2 × 2 matrices appearing in the equations. A numerical test of the result thus obtained is presented in comparison with the corresponding numerical solution result. Unlike the ordinary WKB method, the present method is completely free of the connection formulas of the WKB approximation. (auth)

5094 EIKONAL PERTURBATION THEORY OF ONE DIMENSIONAL QUANTUM MECHANICS. Andrianov, A. A. (Leningrad State Univ.). Yadern. Fiz.; 20: No. 3, 589-601(Sep 1974). (In Russian).

The proposed perturbation theory of the one-dimensional Schrödinger equation Green function has the eikonal structure at every step of iteration. This theory is of the multiplicative type. n iterations of the theory include 2^n terms of the Born expansion. The modifications of the eikonal theory and the relation to the phase–function method are discussed. (auth)

5095 INVESTIGATION OF THE WKB AND EXPONENTIAL METHODS IN CASE OF SEVERAL TURNING POINTS. Kolkunov, V. A.; Mel'nikov, V. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 20: No. 3, 602-613(Sep 1974). (In Russian).

Based on the exponential method, the behavior of the solution of the one-dimensional Schroedinger equation is investigated in presence of several classical turning points. The results are compared with the quasiclassical approximation (the WKB method). Formulas are obtained for the refraction and transition coefficients. Corrections to the Bohr–Sommerfeld quantization condition are determined in terms of convergent series. (auth)

Quantum Field Theories

Refer also to abstracts 4707, 4764, 4791, 4802, 4819, and 5130.

5096 VERTEX FUNCTION IN QUANTUM ELECTRODYNAMICS WITH COMPENSATING CURRENT. Bechler, A. (Univ., Warsaw). Acta Phys. Pol.; 5B: No. 5, 645-658(1974).

Quantum electrodynamics with compensating current, described previously is further investigated. The problem of the definition of the vertex function in this theory is considered. The main difficulty is contained in the fact that the gauge independent and compensating current dependent photon propagator is, in fact, a projector and therefore its inversion does not exist. Thus, the external photon line in the three-point fermion-fermion-photon propagator cannot be cut in an unambiguous way. It is shown however, that the vertex function can be defined analytically in an unambiguous way by means of the effective external field analogous to the one used in the usual version of the theory. The problem of the renormalization of the gauge-independent vertex function is also considered and it is shown that this quantity obeys the integral equation analogous to one obtained by Brandt with the help of the Wilson expansion. Expressions are given for the electron self-energy part and the second integral equation fulfilled by the vertex function. (auth)

5097 MULTIPLICATION LAW IN QUANTUM PHYSICS. II. The Relativistic Quantum Field Theory. Kapuscik, E. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol.; 5B: No. 5, 663-675(1974).

A new construction of the quantum field theory is proposed. The general multiplication law for relativistic quantum field theory is discussed. The method is illustrated by the examples of the free field theory and the interacting fields in the so-called one-particle approximation. (auth)

5098 SPONTANEOUS EMISSION IN THE PRESENCE OF AN APPLIED FIELD. Burckel, W. P. Rochester, NY; Univ. of Rochester (1974). 160p. University Microfilms Order No. 74-22,566.

Thesis (Ph. D.).

Theoretical results are given for the problem of the interaction of a strong monochromatic field and a one-electron atom for the purpose of providing a theoretical basis for new experimental checks of quantum electrodynamics (QED). A purely quantum electrodynamic treatment without semiclassical approximations is used and the calculations are carried out with an emphasis on experimental observables such as emission and absorption spectra. (Diss. Abstr. Int., B)

5099 CANONICAL FORMULATION OF INSTANTANEOUS ELECTRODYNAMICS. Gravitation. Hirondel, D. Newark, DE; Univ. of Delaware (1974). 282p. University Microfilms Order No. 74-22,210.

Thesis (Ph. D.).

After proving that particle positions cannot be canonical variables, a canonical formulation of instantaneous action-at-a-distance electrodynamics is found to all orders in e_1e_2; it is formally the same as for free particles: $\delta\int \vec{f}_1 . d\vec{q}_1 + \vec{f}_2 . d\vec{q}_2 - (\sqrt{m_1^2 + f_1^2} + \sqrt{m_2^2 + f_2^2})dt = 0$. External and internal motions are separated. The problems of convergence in e_1e_2 and of quantization with some: $\vec{q}_i(\vec{r},\vec{v}_1,\vec{v}_2) = \vec{r}_i + (e_1e_2)\vec{q}_i^1(\vec{r},\vec{v}_1,\vec{v}_2) + (e_1e_2)^2\,\vec{q}_i^2(\vec{r},\vec{v}_1,\vec{v}_2) + \ldots$ are mentioned. The order reduced accelerations for three charges are found. Causality is discussed in the context of instantaneous electrodynamics. The EIH gravitational accelerations are proved to satisfy Currie Hill conditions. The EIH Lagrangian is recovered from the Schwarzschild metric in harmonic coordinates by a Lorentz transformation. (Diss. Abstr. Int., B)

5100 NUMERICAL SOLUTION OF V–THETA SCATTERING EQUATIONS FOR A LEE MODEL WITH PSEUDOSCALAR COUPLING. Vaccaro, J. Potsdam, NY; Clarkson Coll. of Tech. (1974). 140p. University Microfilms Order No. 74-23,209.

Thesis (Ph. D.).

Numerical solutions are presented for the singular integral equations which arise in the V–θ sector of the Lee model (N, V, θ particles) with pseudoscalar coupling. Analytical solutions for this sector for the scalar coupling case have previously appeared in the literature and are well known to be independent of the V,N particle spin. When the coupling is made pseudoscalar, the equations are modified in a nontrivial way and a numerical solution was performed. The model is an example of a soluble theory with a production channel and in the scalar coupling case can be carried through analytically. In the pseudoscalar case, the problem can still be reduced to a set of singular integral equations very similar to the scalar case. Results are given for several cases of a parametrized cutoff function which appears in the theory and must be specified for numerical work. For a variety of cutoff functions, a peak is present in the cross section but the phase shift remains small. Results indicate that, in contrast to the scalar case, sharp peaking in the cross section is possible near the production threshold although kinematical effects alone do not insure such peaking. The principal concern is with the qualitative behavior of the simple model, and detailed fits of experimental examples are not arrived at. General results indicate that results are not insensitive to the detailed nature of the assumed a priori arbitrary cutoff function. (Diss. Abstr. Int., B)

5101 WEYL GEOMETRY AS A PARTICLE GEOMETRY. Rothwell, P. L. (Air Force Cambridge Research Labs., Bedford, Mass. (USA)). Phys. Lett., A; 49: No. 2, 154(26 Aug 1974).

It is shown that a stress-tensor which is a curvature source for a Weyl geometry must contain an antisymmetric component. Otherwise the Weyl geometry is equivalent to a Riemannian geometry via a gauge transformation. (auth)

5102 THEORY OF RADIATION REACTION AND ATOM SELF-ENERGIES. All-Order Perturbation Theory of the Generalized Non-Relativistic Lamb Shift. Bullough, R. K.; Caudrey, P. J.; Obada, A. S. F. (Univ. of Manchester, Eng.). J. Phys., A (London); 7: No. 13, 1647-1663(1 Sep 1974).

A natural all-order decorrelation procedure is described for the interaction of a single two-level atom with all modes of the radiation field which replaces the semi-classical boson approximation for the atom by an exact fermion treatment. In consequence, the vacuum Lamb shift appears as twice the Bethe shift for each level separately instead of the limiting neoclassical shift obtained in the Bose theory. Stimulated emission and absorption modify the Einstein A coefficient, and the vacuum shift is extended to include a field dependent shift. Mass renormalization terms apparently particular to the two-level atom, one field dependent the other not, also arise; but the kinetic mass renormalization which appears in the boson theory is identically eliminated. The all-order decorrelated perturbation theory yields an equation of motion for the single-atom dipole moment which includes those reported from operator radiation reaction theory recently; but it also generalizes these by including the effects of stimulated processes. The method is extended to a many-atom case in which it becomes necessary to modify the procedure slightly. The theory gives exponential decay of the dipole density waves travelling through an attenuator and the decay constant is modified by stimulated terms proportional to the field intensity. There is corresponding exponential growth in the amplifier. (auth)

5103 EXISTENCE OF WEISSKOPF–WIGNER TYPE THEORIES. Grimm, E.; Ernst, V. (Technische Univ., Munich). J. Phys., A (London); 7: No. 13, 1664-1675(1 Sep 1974).

It is shown that certain features of the Weisskopf–Wigner theory of natural line width (Z. Phys.; 63: 54-73 (1930)) can be generalized for the construction of a systematic, mathematically and logically autonomous approximation scheme for treating the interaction of a bound electron with photons. This scheme is equipped with its own hierarchy of orders which are not ruled by powers of the coupling constant. Under very weak conditions on the bound electron all Weisskopf–Wigner theories of finite order exist as ordinary quantum theories on ordinary Hilbert spaces H_I and have strictly unitary time evolution operators $U_I(t)$, $t < \infty$. This implies in particular that in such theories the interaction of any finite number of states of the Dirac hydrogen atom with any bounded number of photons can never lead to divergencies. If an infrared catastrophe is banned by a small photon mass $\mu > 0$, Weisskopf–Wigner-type theories of the interaction of an "m-level atom", $m < \infty$, with any unbounded number of photons can also exist and have strictly unitary times evolution operators. Some examples of novel applications of Weisskopf–Wigner type theories are given. (auth)

5104 INVARIANT QUANTIZATION OF THE VECTOR MESON FIELD. Hall, S. F. (Univ. of Liverpool). J. Phys., A (London); 7: No. 12, 1369-1373(11 Aug 1974).

A method is given for computing the equal-time commutators of a Bose–Einstein field with constraints, directly from the Lagrangian density, without necessitating the introduction of conjugate variables or solving equations of motion. The method is illustrated by the vector meson field. (auth)

5105 EFFECTIVE–LAGRANGIAN FORMULATION OF GENERALIZED VECTOR DOMINANCE. Glück, M. (Institut für Theoretische Physik (III) der Universität Marburg, Marburg(Lahn), West Germany). Phys. Rev. D 10: No. 4, 1315-1320 (15 Aug 1974).

The Lagrangian of Lee and Zumino is generalized to include several vector mesons. Their mutual interactions are chosen so as to guarantee a current–vector–fields proportionality relation analogous to the original current–field proportionality relation of Kroll, Lee, and Zumino. Implications of the new Lagrangian for the electromagnetic couplings of charged vector mesons are studied. It is shown, in particular, that the $\rho^{*}(770)$ can carry any magnetic moment in this scheme. (auth)

5106 PROOF OF THE CHARGE SUPERSELECTION RULE IN LOCAL RELATIVISTIC QUANTUM FIELD THEORY. Strocchi, F. (INFN, Sezione di Pisa, Scuola Normale Superiore, Pisa, Italy); Wightman, A.S. J. Math. Phys. (N.Y.) 15: No. 12, 2198-2224 (Dec 1974).

The paper interprets and proves the charge superselection rule within the framework of local relativistic field theory as the statement that the charge operator commutes with all quasilocal observables. Once the basic formalism expressing the property of locality of the observables has been accepted, the proof is an elementary application of Gauss law relating the electric charge in a region to the flux of electric field through the boundary of the region. Most of the paper is devoted to the evidence that the indefinite metric formalism and its accompanying definitions of gauge, gauge transformation, and gauge invariance are internally coherent and consistent with the evidence from free field theory and the renormalized perturbation theory of coupled fields. The paper closes with speculations on analogous explanations of the baryon and lepton superselection rules within the framework of gauge models of strong and weak interactions. (auth)

5107 RELATIVISTIC QUANTUM MECHANICS AND LOCAL GAUGE SYMMETRY. Roman, P.; Leveille, J.P. (Department of Physics, Boston University, Boston, Massachusetts 02215). J. Math. Phys. (N.Y.) 15: No. 12, 2053-2062 (Dec 1974).

The requirement that (either Abelian or non–Abelian) local symmetry transformations be globally and unitarily implementable kinematical symmetries of relativistic systems implies the emergence of a dynamical group which has been suggested in earlier studies. The group leads to a 4–velocity operator and to the Newton–Wigner position operator. Demanding gauge invariance of localization determines a unique interaction structure. Superselection rules for the gauge charges arise. (auth)

5108 NEW SOLVABLE RENORMALIZATION–GROUP EQUATIONS. Lee, S.Y. (Department of Physics, University of California, San Diego, La Jolla, California 92037). Phys. Rev. D 10: No. 4, 1103-1109 (15 Aug 1974).

A new set of renormalization–group equations based on the renormalization procedure of 't Hooft and Veltman used in conjunction with the dimensional regularization scheme is presented. These equations have in common with the renormalization–group equations recently introduced by Weinberg the property of being solvable before passing to the high–energy limit. But unlike Weinberg's equations which are valid only for theories without scalar fields, they are applicable to all renormalizable theories. It is shown that for theories to which Weinberg's approach is applicable, they take the same form as Weinberg's equations. The properties and solution of the equations are discussed. (auth)

5109 NONPERTURBATIVE CALCULATION OF THE PROPAGATOR FUNCTION IN A ONE–DIMENSIONAL MODEL FIELD THEORY. Biswas, S.N.; Vidhani, T. (Physics Department, Visva–Bharati University, Santiniketan, West Bengal, India). Phys. Rev. D 10: No. 4, 1366-1368 (15 Aug 1974).

The eigenvalue equation of a model one–dimensional Hamiltonian for a given field with self–interaction has been reduced to a second–order difference equation. A Green's operator for the difference equation is introduced and, identifying the one–particle matrix element of the Green's operator as the propagator function for the field, a continued–fraction representation for the propagator is obtained. A generalized continued–fraction form for the n–particle matrix element of the Green's operator is also given. (auth)

5110 ABSENCE OF RUNAWAYS AND DIVERGENT SELF–MASS IN NONRELATIVISTIC QUANTUM ELECTRODYNAMICS. Moniz, E.J. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 and Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104); Sharp, D.H. Phys. Rev. D 10: No. 4, 1133-1136 (15 Aug 1974).

We derive the quantum–mechanical operator equation of motion for a point electron and show that (i) the electrostatic self–mass of a point electron is zero in quantum mechanics; (ii) the equation of motion does not admit runaway solutions; (iii) the correspondence limit of the solutions of the quantum–mechanical equation likewise does not display runaways; and (iv) the solutions do not violate the principle of causality in quantum mechanics. (auth)

5111 $\Delta S = 2$ EFFECTS AND HIGGS–BOSON MASSES IN A GAUGE–FIELD MODEL. Munczek, H. (Department of Physics and Astronomy, University of Kansas, Lawrence, Kansas 66044). Phys. Rev. D 10: No. 4, 1345-1349 (15 Aug 1974).

We discuss some $\Delta S = 2$ loops in the context of the Bars–Halpern–Yoshimura unified gauge model. Evaluation of the $K_L - K_S$ mass difference restricts some of the Higgs–boson masses to be only a few GeV. (auth)

5112 MODIFIED ELECTRON PROPAGATION FUNCTION IN STRONG MAGNETIC FIELDS. Tsai, W. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 10: No. 4, 1342-1345 (15 Aug 1974).

The lowest–order radiative correction to the electron propagation function in homogeneous magnetic fields is calculated exactly, using an explicit form of the electron propagation function obtained by Schwinger in 1951. (auth)

5113 UNSTABLE GOLDSTONE BOSONS AND THE ELIMINATION OF SCALAR PARTICLES FROM GAUGE THEORIES. Hammer, C.L.; DeFacio, B. (Ames Laboratory–United States Atomic Energy Commission, and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. D 10: No. 4, 1225-1236 (15 Aug 1974).

One of the key ingredients in the gauge field theories which unify electromagnetism and weak interactions is spontaneous symmetry breaking. A source of instability is given for the Goldstone bosons and the details of the procedure for taking a quotient space and eliminating certain negative metric and/or unstable fields are given. It is then shown that a suitable symmetry breaking combined with unstable Goldstone bosons can lead to massive vector bosons without any superfluous massless scalar bosons. The gauge transformation properties of the "in" fields are also discussed. (auth)

5114 SEMICLASSICAL REPRESENTATION OF NONRELATIVISTIC QUANTUM ELECTRODYNAMICS. Gordov, E.P.; Tvorogov, S.D. (Institute of Atmospheric Optics, Siberian Branch of the U.S.S.R. Academy of Sciences, Tomsk, U.S.S.R.). Phys. Rev. D 10: No. 4, 1182-1184 (15 Aug 1974).

It has been shown that the solution of the quantum–electrodynamic problem for a strong field can be determined according to a known solution of the corresponding semiclassical problem. Series expansions for the operators in the Heisenberg representation according to deviation of semiclassical results from quantum–electrodynamic results have been written. (auth)

5115 INVARIANT BILINEAR FORMS AND THE DISCRETE SYMMETRIES FOR RELATIVISTIC ARBITRARY–SPIN FIELDS. Hurley, W.J. (Department of Physics, Syracuse University, Syracuse, New York 13210 and Center for Particle Theory, The University of Texas, Austin, Texas 78712). Phys. Rev. D 10: No. 4, 1185-1200 (15 Aug 1974).

The existence of an Hermitianizing matrix η is usually assumed in the study of the first–order relativistic wave equations because it provides for an invariant scalar product, bilinear densities (e.g., Lagrangian), and parity realization in a canonical way. However, an η will exist only if the representation of SL(2, C) which governs the transformation of the wave function is self–conjugate. The drawbacks of this fact for theories with $s > 1$ are discussed and a class of relativistic wave equations which avoids these drawbacks and which does not allow for the existence of an η matrix is set aside for study. It is shown that a dual space may be defined (or, equivalently, a metric operator may be introduced) such that all of the above η–matrix benefits may be maintained without an η matrix. The discrete symmetries are defined for these equations and it is shown that the realization of parity in terms of an antilinear operator naturally emerges. The locality, positive–definite metric, and positive–definite energy of the second–quantized version of the formulation is described. These considerations apply to a class of wave equations which provide a simple and uniform description of a massive, spin–s relativistic particle and which remain consistent and causal in the presence of a minimally coupled external electromagnetic field. (auth)

5116 NEW METHODS FOR THE RENORMALIZATION GROUP. Collins, J.C.; Macfarlane, A.J. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge, England). Phys. Rev. D 10: No. 4, 1201-1212 (15 Aug 1974).

The class of renormalization procedures with mass–independent counterterms is considered. It is shown to be nonempty. All these procedures, of which 't Hooft and Weinberg have given particular examples, lead to equivalent renormalization–group equations, which can be solved at arbitrary momenta, unlike the equations in the Gell–Mann–Low and Callan–Symanzik methods. Dimensional regularization is used throughout, as needed for non–Abelian gauge theories. It is shown how Weinberg's method using an ultraviolet cutoff extends to one using dimensional regularization. Finally, some calculations in quantum electrodynamics are exhibited. (auth)

5117 SCALING BEHAVIOR OF ϕ^4 THEORY AND DIMENSIONAL REGULARIZATION. Collins, J.C. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge, England). Phys. Rev. D 10: No. 4, 1213-1218 (15 Aug 1974).

The new method for the renormalization group invented by 't Hooft is applied to ϕ^4 theory. It is verified by explicit calculation of two–loop diagrams that the method avoids the infrared problems which give trouble for Weinberg's new method in field theories with scalar fields. (auth)

5118 DERIVATION OF GAUGE INVARIANCE FROM HIGH–ENERGY UNITARITY BOUNDS ON THE S MATRIX. Cornwall, J.M.; Levin, D.N.; Tiktopoulos, G. (Department of Physics, University of California at Los Angeles, Los Angeles, California 90024). Phys. Rev. D 10: No. 4, 1145-1167 (15 Aug 1974).

A systematic search is made for all renormalizable theories of heavy vector bosons. It is argued that in any renormalizable Lagrangian theory high–energy unitarity bounds should not be violated in perturbation theory (apart from logarithmic factors in the energy). This leads to the specific requirement of "tree unitarity": the N–particle S–matrix elements in the tree approximation must grow no more rapidly than E^{4-N} in the limit of high energy (E) at fixed, nonzero angles (i.e., at angles such that all invariants $p_i \cdot p_j$, $i \neq j$, grow like E^2). We have imposed this tree–unitarity criterion on the most general scalar, spinor, and vector Lagrangian with terms of mass dimension less than or equal to four; a certain class of nonpolynomial Lagrangians is also considered. It is proved that any such theory is tree–unitary if and only if it is equivalent under a point transformation to a spontaneously broken gauge theory, possibly modified by the addition of mass terms for vectors associated with invariant Abelian subgroups. Our result suggests that gauge theories are the only renormalizable theories of massive vector particles and that the existence of Lie groups of internal symmetries in particle physics can be traced to the requirement of renormalizability. (auth)

5119 FIELD THEORY OF RELATIVISTIC STRINGS. I. TREES. Kaku, M.; Kikkawa, K. (Department of Physics, The City College of the City University of New York, New York, New York 10031). Phys. Rev. D 10: No. 4, 1110-1133 (15 Aug 1974).

We present an entirely new kind of field theory, a field theory quantized not at space–time points, but quantized along an extended set of multilocal points on a string. This represents a significant departure from the usual quantum field theory, whose free theory represents a definite set of elementary particles, because the field theory on relativistic strings can accommodate an infinite set of linearly rising Regge trajectories. In this paper, we (1) present canonical quantization and the Green's function of the free string, (2) introduce three–string interactions, (3) resolve the question of multiple counting, (4) complete the counting arguments for all N–point trees and, (5) introduce four–string interactions which yield a Yang–Mills structure when the zero–slope limit is taken. In future work, we will discuss loops and explicitly calculate Reggeon–Pomeron and Pomeron–Pomeron interactions. (auth)

5120 POSSIBLE EXPERIMENTAL BEHAVIOR OF TACHYON MONOPOLES. Mignani, R. (Univ., Rome); Recami, E. Lett. Nuovo Cim.; 11: No. 8, 417-420(26 Oct 1974).

It is shown that in an electromagnetic field, superluminal electric charges do actually behave as magnetic monopoles are supposed to do apart from the different speed. (JFP)

5121 VARIATION PRINCIPLE OF FINSLER SPACES. Takano, Y. (Yokohama National Univ., Japan). Lett. Nuovo Cim.; 11: No. 10, 486-490(9 Nov 1974).

The variational principle for the multiple integral in Finsler spaces by which the equations of the fields of elementary particles and the gravitational field are derived is established. (JFP)

5122 LAGRANGIAN FORMULATION FOR ARBITRARY-SPIN FIELDS. Singh, L. P. S. Rochester, NY; Univ. of Rochester (1974). 145p. University Microfilms Order No. 74-22,630. Thesis (Ph. D.).

The problem of constructing a consistent relativistic quantum theory of fields with spin greater than one is among the most challenging ones of present day physical theory. Extremely intriguing inconsistencies are encountered at every step. One of the major difficulties has been the lack of a unified framework which would allow a study of an arbitrary-spin field. To obtain such a unified framework, in the context of Lagrangian field theory, is the main objective. There is some ambiguity in constructing a theory for higher spin fields, in that one can start with any of several nonequivalent formalisms as defined by various sets of wave equations. Insofar as the resolution of the inconsistencies is concerned, it appears sufficient, however, to work with any one of these formalisms, and our attention is restricted to what has come to be known as the Dirac-Fierz-Pauli (DFP) formalism. This involves wave functions which are symmetric traceless tensors/tensor-spinors. (Diss. Abstr. Int., B)

5123 GAUGE THEORY OF THE WEYL GROUP. Charap, J. M.; Tait, W. (Queen Mary Coll., London). Proc. Roy. Soc. (London), Ser. A; 340: No. 1622, 249-262(24 Sep 1974).

The construction of field theory which exhibits invariance under the Weyl group with parameters dependent on space–time is discussed. The method is that used by Utiyama (Phys. Rev.; 101: 1597-1607 (1956)) for the Lorentz group and by Kibble (J. Math. Phys.; 2: 212-221 (1961)) for the Poincaré group. The need to construct world-covariant derivatives necessitates the introduction of three sets of gauge fields which provide a local affine connexion and a vierbein system. The geometrical implications are explored; the world geometry has an affine connexion which is not symmetric but is semi-metric. A possible choice of Lagrangian for the gauge fields is presented, and the resulting field equations and conservation laws discussed. (auth)

5124 GREEN'S FUNCTIONS IN RENORMALIZED EIKONAL PERTURBATION THEORY: PROPAGATORS AND ANOMALOUS DIMENSIONS. Oleari, C.; Orzalesi, C. A. (Univ., Parma, Italy). Lett. Nuovo Cim.; 11: No. 9, 471-476(2 Nov 1971).

A systematic analysis if given of the properties of the basic Green functions in eikonal perturbation theory is initiated by discussing the asymptotic properties of renormalized propagators in lowest order eikonal perturbation theory. These asymptotic properties are of particular practical interest in that they provide a crucial test of the accuracy of eikonal perturbation theory as a high energy approximation in quantum field theory. (JFP)

5125 NEUTRAL-TACHYON DEFLECTION IN THE SUN'S GRAVITATIONAL FIELD. Sum, C. P. (Univ. of Hawaii, Honolulu). Lett. Nuovo Cim.; 11: No. 9, 459-463(2 Nov 1971).

The plausible existence of a superluminal particle in the framework of special relativity is considered. It is concluded that if tachyons do exist, as predicted by the special theory and if their gravitational mass is indeed equal to the magnitude of their rest mass, they are deflected toward the sun in the sun's gravitational field. The deflection decreases monotonically with increasing tachyon velocity; and at infinite speed a neutral tachyon is deflected towards the sun by an amount equal to half as much as that for the photon. (JFP)

5126 EQUIVALENCE-RESTRICTED OPEN-SHELL SCF THEORY. Jackels, C. F.; Davidson, E. R. (Univ. of Washington, Seattle). Int. J. Quant. Chem.; 8: No. 5, 707-714(Sep 1974).

A method is presented for generating open-shell equivalence-restricted SCF orbitals in high symmetry situations using Roothaan–Hartree–Fock programs which are adapted for lower symmetry. (auth)

5127 WIGHTMAN'S INTERPRETATION OF HAAG'S THEOREM. Riml, H. Lett. Nuovo Cim.; 11: No. 9, 449-453 (2 Nov 1971).

It is shown that although the arguments of Wightman and Haag are quite indisputably correct, the conclusion drawn from them is not. That is, the argument does not rule out the existence of the time evolution operator of relativistic perturbation theory. (JFP)

5128 SCHWINGER FUNCTIONS AND THEIR GENERATING FUNCTIONALS. I. Froehlich, J. (Harvard Univ., Cambridge, MA). Helv. Phys. Acta; 47: No. 3, 265-305(1974).

(Euclidean) Markoff fields and in particular the fields of the $P(\varphi)_2$ models in two-dimensional space–time are studied. It is shown that the states on the Markoff fields, i.e. the generating functionals for the Schwinger functions of the $P(\varphi)_2$ models with different boundary conditions, converge as the interaction region tends to $\mathbb{R}^2$. The generating functionals in the infinite volume limit are in 1–1 correspondence with Euclidean invariant measures on L'; (here $L = L_{real}(\mathbb{R}^2)$). Existence of coincident Schwinger functions and continuity in the time arguments are proven. The Wightman axioms are verified for the quantum fields in the infinite volume limit. Some results on the general structure of Markoff field theory are presented. (auth)

Gravitation and General Relativity

Refer also to abstracts 4351, 4732, 5099, and 5121.

5129 INTERACTION OF GRAVITATIONAL RADIATION WITH A UNIFORMLY MAGNETIZED SPHERE. De Sabbata, V.; Fortini, P.; Gauldi, C. (Univ., Bologna). Acta Phys. Pol.; 5B: No. 5, 741-747(1974).

Maxwell equations in the field of a gravitational wave are linearized by means of the weak field approximation. Then the equations are solved in the case of a uniformly magnetized sphere and the dipole electromagnetic radiation power is calculated. These results are applied to compute the electromagnetic radiation emitted by the earth and magnetic neutron stars when hit by gravitational radiation. (auth)

5130 PASSAGE FROM THE FUNDAMENTAL TENSOR $g_{\mu\nu}$ OF THE GRAVITATIONAL THEORY TO THE FIELD STRUCTURE $g_{\mu\nu}$ OF THE UNIFIED THEORIES. Rao, J. R.; Tiwari, R. N. (Indian Inst. of Tech., Kharagpur). Acta Phys. Pol.; 5B: No. 5, 593-603(1974).

A theorem on obtaining exact solutions for a particular field structure from those of vacuum field equations of general theory as well as from some simpler solutions of unified theories is derived. With the help of this result the most general solution for the particular field structure is developed from the already known simpler solutions. The physical implications of this theorem in relation to some of the parallel work of others is discussed. (auth)

5131 GRAVITATION AND QUANTUM MECHANICS OF MACROSCOPIC BODIES. Karolyhazy, F. (Lorant Eoetvoes Univ., Budapest). Magy. Fiz. Foly.; 22: No. 1, 23-85(1974). In Hungarian).

It was attempted to clarify the mutually limiting concepts of space – time geometry and quantum mechanics in order to derive quantitative conclusions concerning the coherence properties of wave functions and to prepare an experimental approach which could indicate the transition from the microscopic to the macroscopic range. A formalism was developed, reflecting the uncertainty of macroscopic coincidences and describing the law which governs the propagation of the wave amplitudes in the unstructured space – time. This formalism, applied to the motion of macroscopic bodies, predicted a small anomaly which is usually over-shadowed by small perturbations but could be detected experimentally under certain, carefully controlled conditions. The theory of measurements in a microsystem was also examined. (Doctoral dissertation, 47 references). (TTT)

5132 GRAVITATION THEORY. Will, C. M. Sci. Amer.; 231: No. 5, 25-33(Nov 1974).

The discussion of gravitational theory covers the requirements of such a theory, weak-field limit, post-Newtonian coefficients, reference frames, the Eotvoes experiment, metric and nonmetric theories, weak equivalence, general relativity, the Brans–Dicke theory, the perihelion of mercury, and the gravitational red shift. (JFP)

5133 RECENT PAPER OF MISRA ET AL. Ward, J. P. (Queen Elizabeth Coll., London). J. Phys., A (London); 7: No. 13, L145(1 Sep 1974).

Reference is made to a paper by Misra et al. (J. Phys. A. Math. Nucl. Gen.; 6: 924 (1973)), which describes some static "solutions" of the Einstein–Maxwell field equations. It is pointed out that the field equation used is incorrect and that the error essentiating implies that one is working with an imaginary electromagnetic field. The correct equation is given. Similar mistakes by others are also mentioned. (UK)

5134 GRAVITATIONAL–RADIATION PRODUCTION USING NUCLEAR EXPLOSIONS. Chapline, G.F.; Nuckolls, J.; Wood, L.L. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. D 10: No. 4, 1064-1065 (15 Aug 1974).

It is shown that it may be possible to produce gravitational–radiation powers in excess of 1 erg/sec with modest–sized nuclear explosions. The gravitational–radiation intensity near the explosion may be sufficiently high to be detectable, permitting general–relativity experiments to be conducted in terrestrial environments. (auth)

5135 GENERAL RELATIVITY WITH SPIN AND TORSION AND ITS DEVIATIONS FROM EINSTEIN'S THEORY. Hehl, F.W. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540); von der Heyde, P.; Kerlick, G.D. Phys. Rev. D 10: No. 4, 1066-1069 (15 Aug 1974).

The field equations of general relativity with spin and torsion (U_4 theory) are considered to describe correctly the gravitational properties of matter on a microphysical level. By an averaging procedure one arrives at a macroscopic field equation, which under normal matter densities coincides with Einstein's equation of conventional general relativity. For very high matter densities, even if the spins are randomly distributed, Einstein's equation breaks down and U_4 theory must be applied. It is shown how the singularity theorems of Penrose and Hawking must be modified to apply in U_4 theory. All known cosmological models in U_4 theory which prevent singularities are shown to violate an energy condition of a singularity theorem. (auth)

5136 ELECTROMAGNETIC FIELDS IN CURVED SPACES: A CONSTRUCTIVE PROCEDURE. Cohen, J.M.; Kegeles, L.S. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. D 10: No. 4, 1070-1084 (15 Aug 1974).

A new procedure for computing electromagnetic fields in curved space–times is presented. With this procedure, the problem is reduced to solving one complex linear scalar wave equation. Many space–times of astrophysical importance may be treated in this manner, including black–hole and neutron–star spaces and cosmological models. (auth)

5137 IMPLICATIONS OF THE SHADOW EFFECT IN THEORIES OF GRAVITATION. Chiang, C.C. (Center for Particle Theory, The University of Texas at Austin, Austin, Texas 78712); Dykla, J.J.; Hwang, A.E. Phys. Rev. D 10: No. 4, 1085-1091 (15 Aug 1974).

Following the idea of the theory of shadow states in quantum field theory, we construct a Newtonian theory and a Whitehead theory of gravitation with shadow gravitational potentials. As a heuristic approach, Einstein's theory of gravitation is modified by introducing the shadow effect. This is achieved by using the effective mass distribution which arises in the Newtonian theory of gravitation with shadow effect as the only nonvanishing component of the stress–energy–momentum tensor of a static point source. It is found that in the static spherically symmetric solution of Einstein's equations, with proper choice of the new dynamical parameter, there is no surface of infinite red shift and the formation of a black hole can be avoided, leaving a naked singularity at the origin. (auth)

5138 WEYL CONFORM TENSOR FOR STATIONARY GRAVITATIONAL FIELDS. Ernst, F.J. (Department of Physics, Illinois Institute of Technology, Chicago, Illinois 60616). J. Math. Phys. (N.Y.) 15: No. 12, 2027-2030 (Dec 1974).

Our formulas for the Weyl conform tensor components generalize results published earlier by Z. Perjés for vacuum fields. We also offer an abstract version of these equations which may shed some light upon their structure. The expressions for the Weyl conform tensor are specialized to the case of small perturbations from a stationary axially symmetric background geometry. The resulting formulas supplement the expressions which Chandrasekhar and Friedman have developed for the components of the Ricci tensor. We anticipate that this will facilitate the comparison of the CF perturbation theory with the recent studies of perturbations of the Kerr metric by Press, Teukolsky, and Wald. In this connection we identify in terms of the CF field variables the fields which are involved in Teukolsky's separable field equations. (auth)

5139 LIMITS OF THE TOMIMATSU–SATO GRAVITATIONAL FIELD. Kinnersley, W. (Department of Applied Mathematics, California Institute of Technology, Pasadena, California 91109); Kelley, E.F. J. Math. Phys. (N.Y.) 15: No. 12, 2121-2126 (Dec 1974).

The Tomimatsu–Sato (TS) solutions of the Einstein field equations are studied in several limiting cases. In the weak–field limit we construct two Newtonian models for the source, one consisting of a rotating disc of radius a/n, the other made up of n complex point multipoles. The "extreme" limit $q=1$ is also examined in detail, and we find there are many distinct ways of taking this limit. We are thereby led to a new two–parameter family of exact solutions which, unlike the TS metrics, are not asymptotically flat. (auth)

5140 A SCALAR–TENSOR THEORY OF GRAVITATION. Dunn, K.A. (Department of Mathematics, Dalhousie University, Halifax, Nova Scotia, Canada). J. Matlf. Phys. (N.Y.) 15: No. 12, 2229-2231 (Dec 1974).

A scalar–tensor theory of gravitation is constructed using a non–Riemannian geometry in which both the metric tensor and the scalar function have an unambiguous geometric interpretation. The scalar function is introduced by defining a linear connection with nonvanishing torsion. The field equations of the theory, and the Lagrangian from which they are derived, are identical to those given by Dicke in an alternate formulation of the Brans–Dicke theory. By using the static spherically symmetric solution to the field equations it is found that, with a proper choice of parameter, this theory agrees with experimental results in the three classical tests of a gravitational theory. (auth)

5141 THE UNIQUENESS OF THE BERTOTTI–ROBINSON ELECTROMAGNETIC UNIVERSE. Tariq, N.; Tupper, B.O.J. (Department of Mathematics, University of New Brunswick, Fredericton, N. B., Canada). J. Math. Phys. (N.Y.) 15: No. 12, 2232-2235 (Dec 1974).

By employing the spin coefficient formalism of Newman and Penrose a direct proof is obtained that the Bertotti–Robinson electromagnetic universe is the only conformally flat solution of the source–free Einstein–Maxwell equations for nonnull fields. (auth)

5142 STATICAL SMOOTH EXTENSION OF SCHWARZSCHILD'S METRIC. Stavroulakis, N. (Univ., Limoges, France). Lett. Nuovo Cim.; 11: No. 8, 427-430(26 Oct 1974).

According to the problem formulation, the time coordinate x_0 describes the real line R and the mass center in the origin of ^3R. Consequently, the base manifold is taken to be the topological product $R \times {}^3R = {}^4R$. Known values for the deflection of light rays and the advance of the perihelion of mercury are found. (JFP)

5143 NUMERICAL SUFFICIENT CONDITION FOR DECIDING IF A SPACE-TIME IS INEXTENDIBLE. Duncan, D. P.; Shepley, L. C. (Univ. of Texas, Austin). Nuovo Cim.; 24B: No. 1, 130-134(11 Nov 1974).

A sufficient condition for the inextendibility of a space-time is presented based upon the notion of a "tangent space" at the boundary of the space-time. (auth)

5144 PROPERTIES OF THE DESER-LAURENT THEORY OF GRAVITATION. Mansbach, P. (Brandeis Univ., Waltham, MA). Nuovo Cim.; 24B: No. 1, 11-32(11 Nov 1974).

The flat-space theory of gravitation proposed by Deser and Laurent is studied further. The "Schwarzschild singularity" is closely examined, and found to lead to a real singularity in the behavior of test particles. Two general schemes for the coupling of gravitation to matter are considered. Minimal coupling leads to passive behavior identical with general relativity; fully linearized coupling leads to the result that light no longer follows null geodesics of the effective metric (except to first order), and to apparent inconsistencies in the dogmatic application of kinetic theory. The static interior solution in both coupling schemes is investigated, although not solved exactly. In particular, the nonlocal nature of this theory gives rise to $1/r^3$ terms in the exterior field. These, however, alter the predictions of the theory only in second-order terms, and never to first order. It is inferred that, as in general relativity, there is a limiting value of M/R, above which static solutions do not exist. A numerical study of a pressure-free collapsing dust shell shows that matter can, in this theory, travel faster than c, the velocity of propagation of gravitational waves. Moreover, the shell collapses to within its Schwarzschild radius, though whether it remains there long enough for the formation of a singularity is not ascertained. The Deser-Laurent theory remains a viable if less elegant alternative to general relativity. (auth)

5145 MASSIVE SPIN-½ CONTRIBUTION TO THE GRAVITON PROPAGATOR. De Meyer, H. E. (Rijksuniversiteit, Ghent). Lett. Nuovo Cim.; 11: No. 10, 498-502(9 Nov 1974).

Using the dimensional regularization technique of Capper et al IC 73,26 (1973) and IC 73,32 (1973) the electron loop contribution to the graviton propagator is calculated starting from the Lagrangian density. (JFP)

5146 ON THE ENERGY-MOMENTUM TENSOR IN GAUGE FIELD THEORIES. Freedman, D.Z. (Institute for Advanced Study, Princeton, New Jersey 08540); Muzinich, I.J.; Weinberg, E.J. Ann. Phys. (N.Y.) 87: No. 1, 95-125 (Sept 1974).

The energy-momentum tensor in spontaneously broken non-Abelian gauge field theories is studied. The motivation is to show that recent results on the finiteness and gauge independence of S-matrix elements in gauge theories extends to observable amplitudes for transitions in a gravitational field. Path integral methods and dimensional regularization are used throughout. Green's functions $\Gamma_{\mu\nu}^{(j)}(q;p_1,\ldots,p_j)$ involving the energy-momentum tensor and j particle fields are proved finite to all orders in perturbation theory to zero and first order in q, and finite to one loop order for general q. Amputated Green's functions of the energy-momentum tensor are proved to be gauge independent on mass shell. (auth)

5147 RENORMALIZATION IN THE THEORY OF A QUANTIZED SCALAR FIELD INTERACTING WITH A ROBERTSON-WALKER SPACETIME. Fulling, S.A.; Parker, L. (Physics Department, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53201). Ann. Phys. (N.Y.) 87: No. 1, 176-204 (Sept 1974).

We demonstrate the possibility of removing the divergences in the energy-momentum tensor by identifying divergent terms with renormalizations of the coupling constants in the gravitational field equation, modified to include a cosmological term and terms quadratic in the curvature. The model studied is that of a classical Robertson-Walker metric and a quantized minimally coupled neutral scalar field. The theory is constructed first with an ultraviolet cutoff as a phenomenological ansatz. The cutoff is then removed in an attempt to obtain a more fundamental theory, whereupon the question arises of the covariance and uniqueness of the resulting renormalized energy-momentum tensor. In the case of a massless field in a spatially flat universe, an apparent infrared divergence is discussed from the point of view of operational determination of the renormalized coupling constants. In the other cases, although the divergences are successfully accounted for by renormalization, we are left with finite leading terms which do not appear to be identifiable with geometrical tensors; the significance of this result is under investigation. If these anomalous terms are dropped, the renormalized energy-momentum tensor agrees with that defined by adiabatic regularization, provided that the limit of slow time variation taken in that method is generalized to a limit of "spacetime flatness". (auth)

5148 TYPE-N GRAVITATIONAL FIELD WITH TWIST. Hauser, I. (Physics Department, Illinois Institute of Technology, Chicago, Illinois 60616). Phys. Rev. Lett. 33: No. 18, 1112-1113 (28 Oct 1974).

I have found a type-N gravitational field for which the principal null direction has non-zero twist and which admits exactly one Killing vector. (auth)

5149 FROM RELATIVITY TO MUTABILITY. Wheeler, J. A. (Princeton Univ., NJ). Rev. Mex. Fis.; 23: No. 1-2, 1-57 (1974).

The review of relativity covers Einstein's route to general relativity with its antecedents and consequences, the Cartan derivation for the idea that conservation of the source comes about via the principle that the boundary of a boundary is zero, the most compact formulation of general relativity, from the Hilbert derivation to superspace, and the structure of space-time derived from the group of deformations. Also discussed are Sakharov's derivation for gravitation as the metric elasticity of space, and mutability and beyond. (JFP)

5150 DYNAMICS OF EXTENDED BODIES IN GENERAL RELATIVITY. III. Equations of Motion. Dixon, W. G. (Cambridge Univ., Eng.). Phil. Trans. Roy. Soc. London, Ser. A; 277: No. 1264, 59-119(29 Aug 1974).

A study is made of the motion of an extended body in arbitrary gravitational and electromagnetic fields. In a previous paper (Proc. R. Soc. Lond.; A 319: 509-547 (1970)) it was shown how to construct a set of reduced multipole moments of the charge-current vector for such a body. This is now extended to a corresponding treatment of the energy-momentum tensor. It is shown that, taken together, these two sets of moments have the following three properties. First, they provide a full description of the body, in that they determine completely the energy-momentum tensor and charge-current vector from which they are constructed. Secondly, they include the total charge, total momentum vector and total angular momentum (spin) tensor of the body. Thirdly, the only restrictions on the moments, apart from certain symmetry and orthogonality conditions, are the equations of motion for the total momentum and spin, and the conservation of total charge. The time dependence of the higher moments is arbitrary, since the process of reduction used to construct the moments has eliminated those contributions to these moments whose behavior is determinate. The uniqueness of the chosen set of moments is investigated, leading to the discovery of a set of properties which is sufficient to characterize them uniquely. The equations of motion are first obtained in an exact form. Under certain conditions, the contributions from the moments of sufficiently high order are seen to be negligible. It is then convenient to make the multipole approximation, in which these high-order terms are omitted. When this is done, further simplifications can be made to the equations of motion. It is shown that they take an especially simple form if use is made of the extension operator of Veblen & Thomas (Trans. Am. Math. Soc.; 25: 551-608 (1923)). This is closely related to repeated covariant differentiation, but is more useful than that for present purposes. By its use, an explicit form is given for the equations of motion to any desired multipole order. It is shown that they agree with the corresponding Newtonian equations in the appropriate limit. (auth)

5151 COSMOLOGICAL EFFECTS OF GENERALIZED FIELD EQUATIONS IN RELATIVITY. Jones, J. E. (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), Ser. A; 340: No. 1622, 263-286 (24 Sep 1974).

An autonomous system of equations describing uniform cosmological models is formulated by using the perfect fluid approximation of Einstein's equations. These equations contain an arbitrary function related to the matter content of the universe, which may include negative energy fields. This function, designated α, is assumed to depend on the density and expansion rate of the universe only. Geometrical methods of analysis are used to study the behavior of all models described by this system. The analysis shows that there are only three possible modes of behavior that can be exhibited by a uniform universe. Examples of the first two classes are well known in the "big-bang" and "steady-state" theories. However, it is shown that the familiar theories are not unique, but an infinite number of both such types of model exist for various α. It is also shown that all steady-state models in an expanding universe are stable. The third class of model, associated with periodic behavior, is of two types. The first is demonstrated by a universe which oscillates between expansion and contraction but never achieves infinite density. The second consists of ever-expanding (or contracting) models in which the density and expansion rate oscillate between finite values. These latter models possess evolutionary characteristics on "short" time-scales, while satisfying the "perfect cosmological principle" in the large, and only arise in the presence of gross nonlinearities introduced by the function α. Both the periodic and steady-state classes occur only in the case of negative energy fields. (auth)

5152 LINEARIZED GRAVITY AND THE SOMMERFELD RADIATION CONDITIONS. Hogan, P. A. (Univ. of Texas, Austin). Lett. Nuovo Cim.; 11: No. 9, 464-466(2 Nov 1971).

It is demonstrated that the retarded solution of the vacuum-linearized Einstein equations for a moving point mass does not satisfy Sommerfeld outgoing radiation conditions unless the four-acceleration of the mass vanishes. The coordinate condition is then trivially satisifed. A previous result concerning radiation falling on a moving mass is discussed in the light of these observations. (JFP)

5153 QUANTUM MASS SPECTRUM OF THE KERR BLACK HOLE. Bekenstein, J. D. (Univ. of Texas, Austin). Lett. Nuovo Cim.; 11: No. 9, 467-470(2 Nov 1971).

It is possible to consider heuristically some quantum features of black holes by means of well understood principles and arguments from ordinary quantum theory. Using this approach the possibility is discussed that the mass spectrum of the Kerr black hole may be discrete, and a formula for the allowed mass levels is considered. Also some applications of this formula are considered. (JFP)

5154 GRAVITATIONAL ENERGY AND CONSERVED CURRENTS IN GENERAL RELATIVITY. Keefer, B. G. Vancouver, B. C.; Univ. of British Columbia (1971). 151p. Thesis.

A study is made of physical and geometric considerations which might select usefully distinguished gravitational complexes and reference frames. This investigation is conducted within the vierbein formulation of general relativity. Conserved currents corresponding to generalized energy, momentum, and spin are derived from action principles. These currents transform as vector densities under general coordinate transformations, but depend on the vierbein frame chosen. The expressions for the energy and momentum currents contain three arbitrary constants. Physical examples are used to test possible choices of these constants and possible vierbein frames. The generalized vierbein energy and momentum currents are calculated for asymptotically flat, radiative space-times. The physical requirements that the energy of an isolated system cannot increase when there is no incoming radiation, and that there be invariance under vierbein transformations respecting boundary conditions appropriate to the asymptotic symmetry group, are imposed on the generalized energy integral. These requirements determine a unique expression for the energy current which contains no second order field derivatives. Since the boundary conditions do not specify the vierbein frame everywhere, the distribution of gravitational energy is not well defined even when the concept of total energy is made legitimate by asymptotic space-time symmetry. (MGH)

5155 GENERATION OF SOLUTIONS OF THE BRANS–DICKE EQUATIONS. Sneddon, G. E.; McIntosh, C. B. G. (Monash Univ., Clayton Australia). Aust. J. Phys.; 27: No. 3, 411-416(Jun 1974).

A method given by Geroch (1971) for generating new vacuum solutions from given solutions of Einstein's field equations is extended to the generation of vacuum Brans–Dicke solutions from both vacuum Einstein and vacuum Brans–Dicke solutions. Two theorems by Buchdahl (1972, 1973) on generating new vacuum Brans–Dicke solutions are discussed in relation to the theory. As an example of the theory, the Brans–Dicke version of the NUT solution is found. (auth)

5156 HIGHER ORDER GRAVITATIONAL POTENTIAL FOR MANY-BODY SYSTEM. Ohta, T. (Seikei Univ., Japan); Okamura, H.; Kimura, T.; Hiida, K. Progr. Theor. Phys. (Kyoto); 51: No. 4, 1220-1238(Apr 1974).

Gravitational potential for many-body system is obtained up to post-post-Newtonian order of approximation from the metric tensor derived previously, which is Minkowskian at spatial infinity. The calculation is based on the Lagrangian of Fokker type. The transverse-traceless part of the metric tensor contributes to the potential of post-post-Newtonian order, even to the ^{3}G-static part. The fact that the ^{3}G-static potential includes the contribution from the transverse-traceless part is the manifestation of nonlinear nature of the theory of gravity. The gravitational potential obtained coincides with that calculated in the canonical formalism, but does not coincide with that obtained in the conventional formalism of quantized theory. (auth)

5157 TWO APPROACHES TO FERMION FIELDS IN THE TETRAD THEORY OF GRAVITATION. Minkevich, A. V.; Kudin, V. I. (Belorussian State Univ., Minsk). Dokl. Akad. Nauk BSSR; 18: No. 8, 692-695(Aug 1974). (In Russian).

A comparison is made of two approaches to a description of fermion fields in the tetrad theory of gravitation: an approach which is covariant with respect to tetrad Lorentz transformation with arbitrary parameters, and an approach which is covariant with respect to tetrad Lorentz transformations with constant parameters. It is shown that both approaches lead to the same displacement of atomic energy levels in an external weak gravitational field. Consideration is given to the problem of attaining covariance with respect to tetrad Lorentz transformations with arbitrary parameters within the framework of the second approach by means of introducing a reference field of third rank. The binding constant of this field with sources is estimated. 10 refs. (SJR)

REACTOR TECHNOLOGY AND REGULATION

5158 (FRNC-CONF-120) PROBLEMS OF EQUIPPING AND OPERATING NETWORKS SUPPLIED BY NUCLEAR POWER PLANTS. Conrad, R.; Malaval, J.; Mestres, C. (Electricite de France, 75 - Paris). 1973. 11p. (In French). (CONF-730983-33). Dep. NTIS (US Sales Only) $4.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

The strong growth of nuclear power facilities over the next few years will influence the design and operation of the HV transmission and interconnection network. Various factors linked to the appearance of nuclear power (geographical location, size of plants, unit power of sets) can influence the consistency of networks and the characteristics of some of the equipments used. In addition, stiffer requirements for the dynamic behavior of the network will impinge on automation specifications. Lastly, the network may well be operated under conditions differing markedly from those ruling at present. Nevertheless, the consequences may be relatively limited in aggregate and in any event have little weight compared to the economic reasons for massive recourse to nuclear power as a source of electricity supply. (auth)

5159 EFFICIENT CONSTRUCTION OF NUCLEAR POWER PLANTS. Ponomarev, Yu. V. Energ. Stroit.; No. 1, 7-12(1973). (In Russian).

A scheme for construction of nuclear power plants that provides for a continuous and orderly flow of work is presented. Proper scheduling ensures the conditions necessary for the construction proceeding without interruption and with minimum difficulty. (JWR)

5160 DICTIONARY OF NUCLEAR POWER TECHNOLOGY. Part II. Nuclear Power Plants. German-English. Stattmann, F. Thiemig-Taschenbuecher, Band 48. Munich; Verlag Karl Thiemig (1973). 313p. (In German and English). DM 19.80.

Approximately 7000 nuclear power related words and terms in current usage in Germany, Austria, and Switzerland are compiled with their English equivalents. (JSR)

5161 MAP OF THE WORLD'S NUCLEAR POWER PLANTS. Nucl. Eng. Int.; 19: No. 220, 749-750(Sep 1974).

A colored wall-chart map is presented which shows the approximate locations of the world's nuclear power plants including those planned and those under construction, and indicating the number of units. In addition there is an alphabetical listing which indicates the type of reactor, the gross generating capacity, and the grid reference for each station. (UK)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 3363, 5198, 5258, 5259, 5264, 5271, 5278, 5283, 5376, 5377, 5379, 5384, 5388, and 5389.

5162 (BNWL-SA-5156) CORRELATED FISSION GAS RELEASE MODEL FOR UO_2 AT HIGH TEMPERATURES. Beyer, C. E.; Hann, C. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 5p. (CONF-741017-19). Dep. NTIS $4.00.

From meeting of the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

A model was developed to provide an improved method for the prediction of gas release from LWR-UO_2 fuel because of its important role in reactor safety calculations and the conservatism of available models. The model was fit to a consistent and well characterized set of 45 data points using a multiple linear regression code. 10 references. (auth)

5163 (CEA-CONF-2648) FUTURE PROSPECTS FOR LIGHT WATER REACTORS. Andrieu, J. L.; Michon, X. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Propulsion Nucleaire; Electricite de France, 75 - Paris. Direction de l'Equipement). 1973. 9p. (In French). (CONF-730983-19). Dep. NTIS (US Sales Only) $4.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

The light water reactor is now the main type ordered on an industrial basis for electricity production. Its technical development continues. As regards individual components, progress may be expected with fuel, in the form of fractioning and recycling of plutonium, and in reactor vessels, for which prestressed concrete is opening new horizons, and improved reliability of steam generators. As regards the system of operation, there is reason to expect better adaptation to operating requirements and the implementation of steadily rising unit capacities. (auth)

5164 (NEDO-10993) CORE SPRAY AND BOTTOM FLOODING EFFECTIVENESS IN THE BWR/6. Duncan, J. D.; Leonard, J. E. (General Electric Co., San Jose, Calif. (USA). Atomic Power Equipment Dept.). Sep 1973. 27p.

A core heatup model is used to calculate the thermal response of the fuel assembly cladding in a General Electric BWR after a postulated loss-of-coolant accident. An extensive series of emergency core cooling tests was conducted during November and December 1972 to determine the modifications necessary to make the current model appropriate for calculations of the temperature response in an 8 × 8 bundle. Fifty tests were conducted with a full-scale, electrically heated, stainless-steel-clad mockup of a BWR/6 fuel bundle. Rod-to-rod and rod-axial power variation in the tests were very similar to those in the BWR/6 assembly. Transient simulations of the emergency cooling phase of the loss-of-coolant accident were conducted over a wide range of bundle power, coolant flow rate, and cladding temperature at the start of emergency cooling. The General Electric core heatup model was modified to match the test geometry and the test conditions, and the model was used to predict the thermal response of the test bundle. Predictions of maximum bundle temperature in BWR/6 accident simulations ranged from 30°F below to 100°F above the recorded test maximum bundle temperatures. Therefore, the modified core heatup model is considered appropriate for use in BWR/6 loss-of-coolant calculations. It is concluded that this series of tests provides sufficient justification for the conservative nature of reactor Safety Analysis Report calculations with the modified model using the Atomic Energy Commission Interim Acceptance Criteria assumptions. Therefore, no further confirmatory testing is required to demonstrate the adequacy of the model for application to 8 × 8 fuel geometry. (14 references) (auth)

5165 (NP-20178) ANNUAL REPORT OF THE NUCLEAR POWER PLANT AT DODEWAARD FOR 1973. (Gemeenschappelijke Kernenergiecentrale Nederland N.V., Dodewaard). 1973. 98p. (In Dutch).

A detailed survey of all aspects of operation and management of the nuclear power plant at Dodewaard is presented. Items of particular interest are: comparison of hours/days lost in routine inspection plus maintenance and emergency stops; an availability of 99% during the year, after 82.5% the previous year; the relatively-high cost of replacement of parts and materials not only for the reactor but also for the turbines and cooling systems; adaptation of the core spray system to new zirconium temperature standards of the USAEC; reduction of the radiation burden for personnel by modification of the maintenance jobs; chemistry and liquid waste disposal; research on fuel elements. (NL)

5166 (TID-8200-R30) NUCLEAR REACTORS BUILT, BEING BUILT, OR PLANNED IN THE UNITED STATES AS OF JUNE 30, 1974. (USAEC Office of the Assistant General Manager for Energy and Development, Washington, D. C.). 1974. 44p. Dep. NTIS $4.00.

Information is tabulated on nuclear reactor and critical assembly facilities in operation, shut down, under construction, or planned. The data include name, owner, location, type, power, and startup date. (JWR)

5167 FUKUSHIMA UNIT 1 OPERATING EXPERIENCE. Kawahito, T. (Tokyo Electric Power Co. Inc.). Karyoku Genshiryoku Hatsuden; 24: No. 7, 730-744(Jul 1973). (In Japanese).

Construction of the Fukushima-1 (BWR) reactor was started in 1967, and its operation began in March 1971. Subsequently, the power plant has continued to operate satisfactorily, and was subjected to the third regular inspection in April 1973. The records up to the end of March 1973 show the generation of 5,385 million kWh during a total of 12,465 operating hours, with capacity factor of 66.2%. The disposal of radioactive wastes has been maintained adequately, and the release of gaseous wastes to the environment was about 2 millirem yearly. The following are described: operation of the power plant, maintenance and modifications, regular inspection, the inspection of in-service fuel, the control of radioactive wastes, radiation control, and future problems. (JA)

5168 PRESSURIZED AND BOILING WATER REACTORS UP TO THE YEAR 2000. Traube, K. (INTERATOM, Bensberg, Ger.). pp 37-47 of Umweltschutz bei Nuklearer und Konventioneller Energiegewinnung. Braun, H. (ed.). Stuttgart; Georg Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

The present status of light water reactors is outlined, and the market for these reactors up to the year 2000 is estimated. Probable future technical developments are reviewed. The environmental impact of pressurized and boiling water reactors is evaluated. (JSR)

5169 REACTOR CONTAINMENTS IN PRESTRESSED CONCRETE. Kallero, K. E.; Armirad Betong, A. B. Nucl. Eng. Int.; 19: No. 220, 769-770(Sep 1974).

A report is given of reactor containment in Sweden by means of prestressed concrete. The lay-out is described and safety features of the design are discussed. The method of site construction is described. Brief reference is made to pressure and leak tests, which have shown good performance and the question of cost is referred to. (UK)

5170 STACK MONITORING AT A BWR POWER PLANT. Svansson, L. (Aktiebolaget Atomenergi, Studsvik, Sweden). pp 303-315 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

A stack monitoring system, specially designed for monitoring the effluent from a nuclear power reactor, is described. The isotope composition and the pathways for active products out to the stack are presented for a typical boiling water reactor. In particular two important questions are discussed in more detail: firstly the sampling system, divided into a primary circuit and a secondary measuring circuit, and secondly the basic principles for an on-line test and calibration procedure of a stack monitoring system. The principles for system design and system testing have been adopted for all Swedish power reactors of the actual type now in operation or under construction. (auth)

5171 MODEL TESTING OF PRESTRESSED CONCRETE PRESSURE VESSELS OF NUCLEAR REACTORS IN SCANDINAVIA. Maksimov, A. I.; Kirillov, A. P. Energy. Stroit. Rubezhom; No. 2, 10-14(1973). (In Russian).

In 1967 Denmark, Norway, Finland, and Sweden undertook a joint endeavor on the testing of a prestressed concrete pressure vessel for a reactor. The work program provided for the construction and testing of a model. The construction of the vessel differed from previous constructions in that insulation was accomplished through the use of movable metallic jackets. The space between the jacketing and non-movable parts of the vessel was filled with nitrogen or water. The bottom was insulated by thick steel plates. The cover was of reinforced concrete. The system used for sealing the cover provided for small movements of the roof. Stressing of the vessel in the longitudinal direction was achieved by 12 cables applying up to 550 tonne-sec and in the circular direction by 120 cables applying up to 840 tonne-sec. The basic thermal insulation elements were latticed plates of non-corroding wires with a diameter of 0.2 mm assembled in bunches. The model tests provided for verification of the strength of the reinforced concrete vessel, of the reliability of the thermal insulation and cooling system, and sealing of the removable cover. The methods and techniques for carrying out these tests are discussed. Two small-dimension models were tested to destruction in order to determine the character of the failure and the magnitude of the destructive stresses. The strength of the concrete in cylindrical samples was 430 kg/cm^2. The design of the prestressed concrete project permitted the parallel study of the construction of the vessel and the construction of the insulation system. The prestressed model of the pressure vessel made it possible to increase the reactor power. The design development for a boiling water reactor with 2000 MW power was carried out. (tr-auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 5162, 5163, 5166, 5168, 5198, 5258, 5259, 5264, 5271, 5275–5277, 5291, 5353, 5375, 5378, 5380, 5381, 5384, 5388, and 5389.

5172 (ARH-SA-205) SIMILARITY MODEL OF A PWR POWER PLANT. Cardon, K. J. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 12 Sep 1974. Contract AT(45-1)-2130. 6p. (CONF-741017-18). Dep. NTIS $4.00.

From meeting of the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

5173 (BNWL-1842) STATISTICAL ANALYSIS AND MODELING OF GAP CONDUCTANCE DATA FOR REACTOR FUEL RODS CONTAINING UO_2 PELLETS. Lanning, D. D.; Hann, C. R.; Gilbert, E. S. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1974. Contract AT(45-1)-1830. vp. Dep. NTIS $5.45.

Values of the heat conductance across the fuel-cladding gap, h_{GAP}, are inferred by matching fuel temperature data with assumed thermal conductivity of the fuel and clad. In-reactor data for UO_2 pellet fuel are examined, and the BESSEL code is used to estimate fuel surface temperature and clad ID temperature. The variance (due to experimental uncertainties) in the inferred h_{GAP} values is estimated, and correlations of h_{GAP} with design parameters and operating conditions are developed. (DG)

5174 (CENPD-155(Rev.01)) C–E PROCEDURE FOR DESIGN, FABRICATION, INSTALLATION, AND INSPECTION OF SURVEILLANCE SPECIMEN HOLDER ASSEMBLIES. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Sep 1974. 118p.

Combustion Engineering's position on attachment of surveillance holder brackets to the reactor vessel cladding relative to Criterion II.C.2 of 10CFR50, Appendix H is presented. This criterion describes the boundary limits for surveillance capsule placement in the beltline region of the reactor vessel and does not allow attachment of the surveillance holders directly to the vessel wall. (auth)

5175 (FRNC-CONF-110) LARGE STEAM TURBINES FOR NUCLEAR POWER PLANTS. Widmer, M. (Compagnie Electro-Mecanique (CEM), 75 - Paris (France)). 1973. 19p. (In French). (CONF-730983-12). Dep. NTIS (US Sales Only) $4.25.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

The turbines associated with light water nuclear reactors are described. The cycle and the size of exhaust sections are studied together with the criteria for selecting the appropriate r.p.m. The large size of these machines has influenced their shape and design, and these problems are illustrated in terms of a 1250 MW 1800 r.p.m. turbine presently being constructed for a pressurized water reactor in the U. S. A. (FR)

5176 (FRNC-CONF-111) REALIZATIONS IN THE FIELD OF HIGH POWER NUCLEAR TURBINES. Morineau, M. J. (Alsthom-Rateau, 93 - La Courneuve (France)). 1973. 19p. (In French). (CONF-730983-20). Dep. NTIS (US Sales Only) $4.00.

From congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

Particular features of steam turbines used in nuclear power plants are the result of the rapid increase in unit capacity and the steam characteristics delivered by light water reactors. Following are described several designs used in the four 1500 rpm 1000 MW turbines of Fessenheim and Bugey especially concerning protection against erosion, inlet calves, BP rotors assembly and large size diaphragms. (FR)

5177 (FRNC-CONF-115) ADAPTATION OF ALTERNATORS TO THE DEVELOPMENT OF NUCLEAR REACTORS. Dantant, J.; Heuillard, J. F.; Kouskoff, G. (Alsthom, 90 - Belfort (France)). 1973. 26p. (In French). (CONF-730983-34). Dep. NTIS (US Sales Only) $4.50.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

The growing of French nuclear installation has resulted in the manufacturing of four 1500 rpm generators of some 1100 MVA capacity, and 2- and 4-pole units of 1400 MVA capacity are on the drawing board. These new high-rated machines posed electrical, thermal and mechanical problems, whose solution was made easier by the experience gained with the 600 MW 3000 r.p.m. units. The problem of the stator winding blocking can be resolved easily, while the cooling of the rotor on the large two-pole alternator calls on a new system for air-gap pick up of gas. This system has already been tested. A main problem was to get a one-piece forging to avoid the risk of mechanical instability on the shaft-line. As regards transportation, railroads are the only possibility for shipping the stator. (FR)

5178 (FRNC-CONF-119) NUCLEAR POWER PLANT UNDER CONSTRUCTION: Fessenheim. Cordelle, F. (Electricite de France, 92 - Clamart). 1973. 14p. (In French). (CONF-730983-32). Dep. NTIS (US Sales Only) $4.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

The FESSENHEIM nuclear plant, consisting of twin 890 MW PWR reactor units was ordered in 1970, and should come in line in 1975 and 1976. Their equipment is strictly identical. In designing this plant, much attention was paid to safety, continued availability of equipment and the economies to be expected from steadfast insistence on design simplicity. The main lines of action to achieve these aims and the difficulties met are reported. Close planning, design and execution should make it possible to bring several auxiliary equipment into operation as needs emerge, thus avoiding the erection of any provisional facilities on the site. (FR)

5179 (KFK-1983) MEASUREMENTS OF THE DISTRIBUTION OF ACTIVATED CORROSION PRODUCTS IN THE PRIMARY CIRCUIT OF THE OBRIGHEIM NUCLEAR POWER STATION. John, H.; Vehlow, J. (Kernforschungszentrum Karlsruhe (F. R. Germany)). May 1974. 45p. (In German). Dep. NTIS (US Sales Only) $5.50.

Gamma spectroscopy and gamma dose rate measurements were performed on five pipe sections of the primary circuit of the Obrigheim pressurized water reactor. The measurements were intended to establish a relationship between the radioactive contamination with corrosion products and the thermohydraulic operating parameters. The results were interpreted on the basis of recognized laws on the transport of matter. Pipe inlet effects giving rise to the generation of boundary layers were found to have a marked influence on the development of contamination. Over a pipe inlet length of 10 pipe diameters a medium decrease of the radioactive contamination to 25% was observed. The influence of the Re-number on contamination can be described approximately by the Re/d relation. It can be concluded from the dependences found that laminar boundary layers constitute very significant transfer barriers to the plate-out of radioactive corrosion products also in the ranges of Re-numbers and temperatures encountered in pressurized water reactors. (auth)

5180 (WCAP-8339) WESTINGHOUSE EMERGENCY CORE COOLING SYSTEM EVALUATION MODEL: SUMMARY. Bordelon, F. M.; Massie, H. W. Jr.; Zordan, T. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Jun 1974. 68p. Dep. NTIS $6.50.

An overview is presented of the Westinghouse Emergency Core Cooling Systems (ECCS) Evaluation Model which has been developed in accordance with the Atomic Energy Commission's (AEC) regulations 10CFR50.46. Compliance of the Westinghouse Evaluation Model with the requirements of Appendix K of 10CFR50 is demonstrated. Computer code interfaces and the method of analysis for the evaluation of ECCS performance are discussed. (13 references) (auth)

5181 (WCAP–8394) ROTO-LOK CLOSURE SYSTEM DESIGN. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Oct 1974. 22p.

On the basis of the prototype hardware tests and the photoelastic tests of the square lug, it was apparent that the original square lug design proved to be very satisfactory and that this design met the ASME code requirements. The three dimensional square lug photoelastic test results were in very good agreement with the prototype hardware test results. The photoelastic results were within ten percent of the results obtained by strain gages on the prototype hardware. The data from the two dimensional sawtooth photoelastic test confirmed and were practically identical to the analysis and comparison of the sawtooth configuration with the square lug configuration. These tests and analyses, in conjunction with the complete Roto-Lok assembly half-scale plastic model of the sawtooth configuration, also confirmed that the Roto-Lok sawtooth assembly conformed to Westinghouse design criteria as well as being within the requirements of the ASME Code and well within the ASME Code allowable fatigue usage factor. (auth)

5182 PLANS FOR THE IKATA NUCLEAR POWER STATION. Nonaka, H. (Shikoku Electric Power Co. Inc., Takamatsu, Japan). Genshiryoku Kogyo; 19: No. 9, 39–44(Sep 1973). (In Japanese).

To cope with the increase in power demand and to attain the diversification in energy resources, the Ikata nuclear power station is being built by Shikoku Electric Power Company. Located in the town of Ikata, Ehime Prefecture, the PWR station will have an output of 566 MW(e), and completion is expected in April 1977. The site was selected in 1970, and construction work was started in June 1973. The following are described: The station site and its geology, weather, hydrology, etc.; layout; plant facilities, including electrical equipment, sea-water desalination for water supply, and waste treatment; construction program; and measures of environmental protection. (JA)

5183 CONSTRUCTION OF TAKAHAMA POWER STATION. Nakagawa, S. (Kansai Electric Power Co. Inc., Osaka). Karyoku Genshiryoku Hatsuden; 25: No. 2, 110-118(Feb 1974). (In Japanese).

Progress in the construction of Takahama-1 and Takahama-2 is reported. Both are PWR type reactors with heat output of 2,440 MW. The power station faces the Sea of Japan. In October 1973, the preliminary testing before fuel loading was completed on the No. 1 unit, and the installation of major components and piping was proceeding in the No. 2 unit. The following are described: siting; station layout; construction schedule; specifications of the power station and its features regarding the reactor plant and the arrangement of equipment; and problems for future study such as early preparation of drawings and reduction of the construction period. (JA)

5184 FAST REFUELLING SYSTEM. Nucl. Eng. Int.; 19: No. 220, 767-769(Sep 1974).

The Westinghouse rapid refuelling system is described. The system is a combination of PWR design innovations which include the following: a quick release reactor head; elimination of electrical disconnects; a one-lift concept in which the missile shield, reactor vessel head, upper core-support structure and rod cluster control assemblies are removed as a single unit; withdrawal of the rod cluster control assemblies into the head and upper internals package where they are held withdrawn during refuelling and improved fuel handling through refinements in the manipulator crane system. These improvements reduce the number of handling operations from 2300 to 230. Also described briefly are several modifications in the refuelling containment. The performance requirements for the cleaning up of the reactor coolant system and the removal of waste gas are also briefly discussed. (UK)

5185 STEAM POWER PLANT FOR NUCLEAR POWER STATIONS WITH PRESSURIZED WATER REACTORS. Heitmann, H. G. (to Kraftwerk Union A. G., Muelheim an der Ruhr (F. R. Germany)). German Patent 2136185/A/. 1 Feb 1973. 5p. (In German).

1 fig.

A plant is described in which the blowdown water can be recycled by the concentration of impurities. There is a cleaning device in the blowdown pipe in which an electromagnetic filter and mixed-bed filter are so arranged that at least a considerable part of the blowdown water flow can be fed back into the circuit. (GE)

5186 DESIGN OF THE BIBLIS NUCLEAR POWER STATION. Fruehauf, H. (Hochtief A. G., Frankfurt am Main (F. R. Germany). Abt. Kernenergie); Lepie, G. (Kraftwerk Union A. G., Erlangen (F. R. Germany)). Atomwirt., Atomtech.; 19: No. 8/9, 408-419(Aug 1974). (In German).

6 figs.; 6 refs.

The design of the Biblis nuclear power plant is based on the lay-out of the nuclear power plants Obrigheim and Stade and its technical concept represents improvement and further development of these plants. Unit A of the Biblis plant is designed for a gross output of 1,200 MW(e), Unit B for 1,300 MW(e), which means an increase in power output by 100% as compared with the KKS, and required significant changes in design and construction. Whereas the step from the KWO to the KKS brought about a doubling of the coolant loops, the efficiency of every individual coolant circuit has now been doubled in the Biblis plant. This called for a re-design of some components and improvement of manufacturing methods. Substantial improvements have also been made with regard to reactor safety. The control system of the plant has been modified so as to meet the requirements of frequency stability in the interconnected system. (GE)

5187 THE STEAM POWER PLANT OF THE BIBLIS NUCLEAR POWER STATION. Bald, A.; Brix, O. (Kraftwerk Union A. G., Erlangen (F. R. Germany)). Atomwirt., Atomtech.; 19: No. 8/9, 431-438(Aug 1974). (In German).

8 figs.; 2 tabs.; 4 refs.

With a 1,500 revolution saturated steam condensation turbine generator, the nuclear power plant Biblis follows the concept of the Stade nuclear power plant, whose arrangement of valves, water separators and steam superheaters, condenser and spring foundation has also been taken as a basis. The four-poled water-cooled 1,500 MVA generator is at present with a power factor of 0.8 the largest turbogenerator in the world. The steam and feedwater circuit matches that of the conventional plants. Between the reactor plant and the steam power plant there is a pressure-tight partition in the steam generators. Several parallel or one behind another connected systems have been designed for the safe cooling water supply. Of note are new developments with nuclear power pumps. Particular design aspects were valid for the emergency feedwater supply and the ancillary cooling water system. (GE)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 3062, 3443, 5166, 5279, 5293, 5318, 5352, 5353, and 5388.

5188 (CONF-741030-2) ANALYSIS AND MEASUREMENT OF MASS TRANSPORT IN COATED UO_2 AND OTHER HIGH OXIDE PARTICLES. Lindemer, T. B.; de Nordwall, H. J.; Olstad, R. A. (Oak Ridge National Lab., Tenn. (USA)). 1974. 10p. (SM-190/38). Dep. NTIS $4.00.

From symposium on thermodynamics of nuclear materials; Vienna, Austria (21 Oct 1974).

Fuel kernel migration is widely observed in the coated oxide and carbide fuel particles used in high-temperature gas-cooled reactors (HTGRs). The rate of this phenomenon is generally observed to be sufficient to establish operational limits on the time-temperature-power density relationships needed for the design of the HTGR core. On the other hand, it has been difficult to establish the rate-controlling migration mechanism in oxide fuels and thus permit the rate of this mechanism to be determined unequivocally. A description is given of several new and general theoretical methods that can be used to establish experimentally the rate-controlling mechanism, and the developments are applied to the analysis of recent in-reactor kernel migration observed in coated UO_2, $Th_{1-x}U_xO_2$, and ThO_2 particles. The analysis establishes that the kernel migration rate is apparently not controlled by the rate of $CO-CO_2$ diffusion in UO_2, $Th_{1-x}U_xO_2$, or ThO_2 particles. Furthermore, the data indicate that a solid-state diffusion mechanism controls the kernel migration rate. A solid-state kernel migration coefficient (KMC) has been calculated for each particle observed in metallographic cross sections of specimens from several irradiation experiments. The KMC is defined as $(y/t)\ (T^2)\ (dT/dx)^{-1}$, in which y is the observed migration during time t. The coefficients were obtained over the temperature range 900 to 2000°C. The KMC for ThO_2 was less than that for $Th_{1-x}U_xO_2$ at a given temperature; UO_2 had the highest KMC at $T \leq 1200°C$. The activation energy for the UO_2 KMC was ~19 kcal/mole, while that for ThO_2 and $TH_{1-x}U_xO_2$ was ~44 to 45 kcal/mole. No burnup dependence of the KMC could be discerned in either ThO_2 or UO_2. (auth)

5189 (GA-A-12692) CONTEMPT-G COMPUTER PROGRAM AND ITS APPLICATION TO HTGR CONTAINMENTS. (General Atomic Co., San Diego, Calif. (USA)). 7 Oct 1974. 35p. (GA-LTR-6).

Revised and requested information is presented concerning the CONTEMPT-G computer program. (6 references) (DCC)

5190 (GA-A-12808(Vol. 4)) LARGE HTGR STEAM GENERATOR DESIGN VERIFICATION AND SUPPORT PROGRAMS: VIBRATION. Blevins, R. D.; Burton, T. E.; Cheng, S. C.; Kaufman, J. S. (General Atomic Co., San Diego, Calif. (USA)). 30 Sep 1974. 86p. (GA-LTR-5(Amend. 1)).

The objective of the vibrations program for the steam generator is to verify that vibratory stresses due to aerodynamic, acoustic, and seismic excitation forces will be within acceptable limits over the life of the HTGR plant, and to assure that adequate wear protection is provided at points of contact between adjacent components where vibrations can be tolerated. Analytical techniques and testing programs are described. (auth)

5191 (JAERI-M-5690) COMPUTER CODE FOR THE ANALYSIS OF GRAPHITE CORROSION IN HTGR: PEGASUS. Suzuki, K.; Kamada, M.; Kawai, M. (Japan Atomic Energy Research Inst., Tokyo). May 1974. 44p. (In Japanese). NTIS (US Sales Only).

The steam-graphite reaction ($H_2O + C \rightarrow CO + H_2$) is of interest for gas-cooled reactors because of the graphite structural material in HTGR cores and the possible presence of water vapour in the coolant either as impurity or through inleakage from the secondary loops, especially from the steam generator. In order to analyze the effects of the reaction in the reactor core, the computer code "PEGASUS" has been developed in which the problems are formulated mathematically as the unsteady diffusion problem and solved numerically under the third kind of boundary conditions. Some of the assumptions in the code are as follows: (1) the graphite is cylindrically symmetric, (2) the steam-graphite reaction in the core is of the first order, and (3) the transport of reactants into the graphite is governed by their diffusion. The code can be used for the calculation of the following quantities: (1) water vapour concentration as function of time and position in the graphite cylinder, (2) corrosion rates and corrosion losses, (3) linear corrosion of the outermost PyC- layer of coated particle fuel, and (4) depth of the permeation of water vapour into the graphite cylinder. (auth)

5192 (JAERI-M-5713) OPTIMIZATION STUDY OF THE AXIAL POWER AND TEMPERATURE DISTRIBUTIONS IN VHTR WITH APPLICATION OF MODAL EXPANSION METHOD. Yasukawa, S. (Japan Atomic Energy Research Inst., Tokyo). Jun 1974. 28p. NTIS (US Sales Only).

The system model for optimization is as follows: (1) The reactor is simulated by a plane-type core with reflector, (2) the neutron balance equation is approximated by one-group diffusion equation with temperature feedback and fuel depletion effect, (3) maximum fuel temperature and maximum control-rod withdrawal limits are introduced as main constraints, and (4) reactor operating time is treated as the dependent variable. Through a few analyses with the 50 MWt experimental reactor, the following conclusion was revealed: to maximize the reactor operating time under fuel temperature limit, it is necessary to have the power distribution a little higher in the near-coolant-inlet region at initial burnup and to shift the peak power into the center region or toward the coolant outlet side as the reactor operation proceeds. To achieve this, axial fuel zone loading is required. (auth)

5193 (NP-20228) STABILITY OF THE REFLECTOR OF A PEBBLE BED REACTOR. Elter, C. (Technische Hochschule Aachen (F.R. Germany). Fakultaet fuer Maschinenwesen). 4 Jun 1973. vp. (In German). INIS.

With figs. and tabs.; 19 refs. With abstract. Available from the library of the TH Aachen.

The stresses occurring between single spheres and reflector in the pebble bed reactor have been defined and compiled from available experimental results. By theoretical considerations, general relationships have been found with which the geometrical measurements of the reflector surface can be determined. Stability properties of reflector graphites with different parameters have been determined from tests on sample bodies. Besides the determination of the form stability of surfaces and edges with static and increasing induced stress with spheres of the same diameter as the fuel element spheres, the wearing effects due to the labile spheres were examined on the surface elements of a reflector under simulated operational conditions. By means of theoretical considerations on the edge formation and of experimental results, it is possible to predict for different graphites the behavior of the reflector surface during the lifetime of the reactor and to design the reflector in such such a manner that it remains capable of functioning for its intended time of operation. (GE)

5194 (SRD-R-35 (Pt.1)) DEPOSITION OF FISSION PRODUCTS IN A PRIMARY HEAT EXCHANGER OF THE DRAGON H.T.R. Lawler, M. J. (UKAEA Safety and Reliability Directorate, Risley). 1974. 31p. UKAEA, Safety and Reliability Directorate.

The transport and deposition of fission products released from the core of the Dragon H.T.R. at AEE Winfrith into the primary coolant circuit are studied. The heat-mass transfer analogy is applied to the heat exchanger helical tube bundles divided into a number of zones. An iterative method of calculation is developed to obtain heat transfer coefficients which ensures consistency with the known thermal performance of the heat exchanger. Mass transfer coefficients are then calculated from the heat transfer coefficients and a plateout profile is produced using the computer code ADDICT-2. Comparison is made between theory and experiment and good agreement is obtained. (auth)

5195 STUDIES OF PRESTRESSED CONCRETE REACTOR PRESSURE VESSEL. Internal Pressure Experiment with a 1/10 Scale Model and Its Analysis. Hisatomi, Y.; Isobata, O.; Fukada, Y.; Tanaka, N.; Tatebe, M. (Shimizu Construction Co. Ltd., Tokyo). Shimizu Kensetsu Kenkyusho-Ho; No. 21, 37-53(Oct 1973). (In Japanese).

Internal pressure experiments have been performed with a 1/10 scale model of the Prestressed Concrete Reactor Vessel (PCRV) to be used at the Hinkley Point B and Hunterston B stations in the United Kingdom. The purpose of the studies was to ascertain the behavior of the actual PCRV and determine the method of construction. Normal working pressure is 39.1 kg/cm^2, design pressure 43 kg/cm^2, proof pressure 49.5 kg/cm^2, and design ultimate pressure 108 kg/cm^2. The following facts were revealed. (1) Helical prestressing is effective in both horizontal and vertical directions. (2) Within the design pressure, the behavior of the PCRV is elastic. (3) The ultimate pressure, 3.0 times as high as the design pressure, exceeds 2.5 times as design level. The rupture mechanism conceived in design was nearly reproduced by experiment. (4) Sufficient plastic deformation was produced with increase of internal pressure, and the rupture of the test model was gradual. (5) The behavior of the PCRV well agrees with the results of elastic and elastoplastic analyses by finite-element method. The behavior can thus be estimated well by the analysis assuming axis-symmetrical body of rotation. (JA)

5196 DEVELOPMENT TRENDS IN HIGH TEMPERATURE REACTORS. Kraemer, H. (Kernforschungsanlage, Juelich, Ger.). pp 59-66 of Umweltschutz bei Nuklearer und Konventioneller Energiegewinnung. Braun, H. (ed.). Stuttgart; Georg Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

High temperature reactors are not yet economically feasible, but current development trends seem likely to make them so by the year 2000. The primary development trends for these reactors are outlined, and the high temperature reactor with He turbines is discussed in some detail. The use of this type reactor for process heat is considered. The concept of the gas-cooled fast breeder is briefly discussed. (JSR)

5197 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Robinson, J. A. (to Nuclear Power Group Ltd.). British Patent 1,352,324. 8 May 1974. 3p.

The fuel element construction described comprises a block of solid moderator material containing a number of substantially parallel passages each containing two nuclear fuel containing members having cross-sectional dimensions such that when the members are located in a passage there is a clearance between them and the passage walls for the flow of coolant. Each member has a number of axially extending lugs contacting the wall of the passage, and each group of two members is supported in the passage by a member under one of the lugs of the lower fuel containing member so that when the blocks are located in the reactor core with the passages vertical the weights of the members cause them to lean against the passage walls and at least one member leans against the other member in a predictable way. The lower member may be supported on a ledge in the moderator block so as to stand vertically with the upper member resting on an end cap of the lower member, the end cap having a cut-away portion so that the element is caused to lean against the wall of the passage under its own weight. (UK)

5198 WASTE CONTROL MATERIALS AND METHODS USED BY ELECTRICITE DE FRANCE. Martin, J. J. (Electricite de France, Paris). pp 177-179 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974). (In French).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

The materials and methods used for the control of the gaseous and liquid wastes used in graphite–gas, heavy water–gas, and pressurized water reactors in operation and which will be used in the pressurized water and boiling water reactors now under construction or being planned are described. The measurement of the noble gases is continuous and is made with differential ionization chambers. The filtration of the gases before counting with subsequent counting of the filters with a G-M counter gives a determination of the aerosol activity. The filters are connected to a special alarm detector which would signal the release of significant quantities of radioactivity. The liquid wastes are accumulated in reservoirs and released if the total activity is within acceptable limits. In the water reactor at Chooz special measurements are made for ^{3}H and ^{90}Sr. A central laboratory monitors the results obtained at each site. (JSR)

5199 DEVELOPMENT OF PRESTRESSED CONCRETE PRESSURE VESSELS FOR NUCLEAR POWER PLANTS IN THE UNITED KINGDOM. Mikhailov, V. V.; Mikhailov, O. V. Energ. Stroit. Rubezhom; No. 4, 8-17(1972). (In Russian).

The cylindrical form of prestressed reactor vessels has obvious construction advantages which are most favorable during assembly. The diagonal placement of the armature cables in the walls of the reactor vessel is preferable since the number of anchors is reduced with such a system. The cables intersect the entire reactor at an angle of 37° to the horizontal plane in 16 layers in pairs clockwise and counter-clockwise. They are placed in welded pipes of low-carbon steel attached by light steel casings. The character of the destructive testing results of models of the pressure vessels of the reactors of the Oldbury, Hinkley Point B, and Hunterston B power plants corresponds to the theoretical predictions. A continuous increase of deformation up to the limit load was observed, greater by a factor of 2.7 than the calculated value. The Hartlepool nuclear power plant differs in its construction by the fact that the steam generators are located inside the wall of the pressure vessel behind internal steel jacketing. Such a solution makes it possible to increase the power of the reactor and decrease the internal diameter, to reduce both construction and welding operations, to simplify the construction of the steam generator support, to easily assure the radiation shielding of the steam generators, and to alleviate and improve the conditions for the control of the steam generators. Studies of materials for prestressed reinforced pressure vessels performed by the UKAEA showed that at temperatures up to 120°C there is a limiting but acceptable magnitude of loss of compressive strength. With increase of temperature a significant decrease of the instantaneous elasticity modulus was observed. Tests confirmed the significant effect of temperature on the rate of development of creep. Laboratory tests showed the existence of a proportional dependence between creep and stress. The dependence between creep and temperature was linear from 20 to 100°C. Tests showed that relaxation resistance, strength, and metallographic structure of the steel did not change after irradiation. Temperature had a large effect on the relaxation of the stress in the armatures. No less than 70% of the stress relaxation occurring within 5 years took place in the first 1000 hrs. (tr-auth)

5200 NUCLEAR REACTOR MODERATOR BLOCK. Cunningham, C.; Simpkin, S. D. (to British Nuclear Design and Construction Ltd., Whetstone). German(FRG) Patent 2332953/S/. 10 Jan 1974. 13p. (In German).

4 figs.

A prismatic moderator block is described containing fuel accepting channels and coolant channels which lie parallel to one another and to the side surfaces of the block. The coolant channels are in rows according to a net pattern of equilateral triangles and the fuel containing channels in a regular net pattern arranged in such a manner that a fuel containing channel always lies between two coolant channels. Further channels are for the uptake of control rods or manipulating of the block. The claim deals with the arrangement of the channels. (GE)

5201 METHOD FOR THE FABRICATION OF PRISMATIC GRAPHITE COMPACTS FOR HIGH-TEMPERATURE REACTOR FUEL ELEMENTS. Huschka, H.; Rachor, L.; Hrovat, M. (to Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Grossauheim (F. R. Germany)). German Patent 2233071/A/. 31 Jan 1974. 13p. (In German).

2 figs.

A method is described in which the deformation in the pressing of graphite bodies results in more than one dimension simultaneously. The process includes the fabrication of channels for coolant and fuel in the pressed body. Fuel and/or breeder are preferably introduced into the pressed mass in a given distribution in the form of coated particles. Furthermore, the method includes recompacting in one dimension. (GE)

5202 METHOD FOR THE FABRICATION OF SPHERICAL GRAPHITE FUEL ELEMENTS. Hrovat, M.; Spener, G.; Stemplinger, W. (to Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Grossauheim (F. R. Germany)). German Patent 1646783/B/. 3 Jan 1974. 6p. (In German).

2 figs. Available from ZAED.

A method for the preparation of extensive isotropic, spherical fuel elements by pressing a mixture of nuclear fuel particles and a binding agent containing graphite powder is described. The claim deals with the shape of the matrix, the pressing pressure as well as with further technical details of the process. (GE)

5203 GAS-COOLED FUEL ELEMENTS FOR NUCLEAR REACTORS. Hosegood, S. B. (to Commission of the European Communities, Luxembourg). German Patent 2329520/A/. 3 Jan 1974. 19p. (In German).

5 figs.

The described gas-cooled thermal reactor is characterized by a multitude of nuclear fuel elements where each fuel element has an external region containing breedable material and an inner region containing fissionable plutonium. Ways are designed which lead a cooling gas through the reactor core so that heat from the inner regions of the fuel element will be removed. The fuel elements are distributed in a mass of moderator material in such a manner that each element is surrounded by moderator material. (GE)

5204 REACTOR CORE FOR GAS-COOLED HIGH-TEMPERATURE REACTORS COMPOSED OF PRISMATIC BLOCKS OF MODERATOR MATERIAL. Hosegood, S. B.; Lockett, G. E. (to Commission of the European Communities, Luxembourg). German Patent 2331505/A/. 17 Jan 1974. 13p. (In German).

1 fig.

A core construction of prismatic moderator blocks is described whose end surfaces are irregular hexagons with each 3 equally long or short sides. In a longitudinal direction running channels contain fuel or coolant. The claim deals with the arrangement and construction of the moderator blocks. (GE)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 3588 and 5198.

5205 (ZJE-150) APPLICATION OF THE "FAULT TREE" METHOD IN RELIABILITY ANALYSIS OF THE A1 REACTOR CONTROL AND SAFETY SYSTEM. Holousova, M. (Skoda, Plzen (Czechoslovakia)). 1974. 30p. Dep. NTIS (US Sales Only) $4.50.

The paper describes a "fault tree" method and its application in reliability analysis of the control and safety system of the A1 nuclear power station. The fault tree is a logic model involving all probable fault combinations of components and subsystems associated with the occurrence of the final undesired event–the system failure. The method allows one to carry out a quantitative and qualitative analysis of the system reliability and availability using a digital computer. The aim of the reliability analysis with the fault tree is to determine the distribution of reliability in the system, to find "weak links" of the considered system, and to define minimum repair times for the components of this system. (auth)

Power Reactors, Breeding

Refer also to abstracts 3575, 5166, 5196, 5260–5262, 5268–5270, 5272, 5280, 5284, 5286, 5317, 5352, and 5353.

5206 (AEC-tr-7581) DESIGN AND CONSTRUCTION OF ENCLOSURES FOR PRIMARY SODIUM SYSTEMS. Hillekum; Leopold; Klockner. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). Sep 1974. Translation by W. J. Grimes of Bulletin No. 45,3425,6. 17p. Dep. NTIS $4.00.

5207 (AEC-tr-7591) CONSTRUCTION AND OPERATIONAL DESCRIPTION OF THE FAST REACTOR CORECATCHER. Freidrich, H.; Knape, H. 8 Aug 1974. Translation of INTERATOM Memorandum No. 43.1947.8. 6p. Dep. NTIS $4.00.

The corecatcher includes the following components: Na-catch tank with inner insulation; base cooler; fuel catching shell with directional spreader and protective layer; double-tank strut; and concrete foundation. Specifications are presented. (auth)

5208 (ANL-CT-75-12) EFFECT OF EXPANSION TANKS AND TEE LOSSES ON PRESSURE TRANSIENTS: PRELIMINARY PARAMETER STUDY. Kot, C. A.; Srinivasan, M. G.; Youngdahl, C. K. (Argonne National Lab., Ill. (USA)). Oct 1974. Contract W-31-109-eng-38. 29p. Dep. NTIS $4.50.

The effects of expansion tanks and Tee junction losses on pressure transients are investigated numerically using the one-dimensional nonlinear fluid-hammer approach. The losses in a Tee junction are modeled using steady state empirical pressure drop coefficients. Large expansion tanks and gas volumes are represented by a quasi-steady model coupled directly to the dynamic response of the fluid pipes connected to them. A simple constant head pump representation is used in the analysis. The results indicate that pressure losses at a Tee junction are minor. In particular, no significant differences of placing a rupture disc in the run or the branch of a Tee can be established by means of the one-dimensional analysis. Typical thermal expansion tank configurations are found to be ineffective in attenuating pressure pulses. The effective mitigation of pressure transients by such gas volumes requires very large connecting passages from the primary flow path to the tank or the direct in-line placement of surge tanks. It is concluded that the effect of rupture disc placement in the run or the branch of a Tee must be investigated by means of multidimensional analysis. Also, more realistic pump models, which take into account the actual response of the device, must be developed to study their pressure pulse transmission characteristics. (auth)

5209 (CEA-CONF-2640) FAST NEUTRON REACTORS: FROM THE INITIAL RESEARCH TO PHENIX. Vendryes, G.; Villeneuve, J.; Faure, J.; Milliat, J. P.; Rozenholc, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. d'Etude et de Developpement des Reacteurs; CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides; Electricite de France, 78 - Chatou. Service Generateurs et Echangeurs de Chaleur Thermiques et Nucleaires; Electricite de France, 78 - Chatou; Groupement pour les Activites Atomiques et Avancees (GAAA), 92 - Le plessis-Robinson (France)). 1973. 18p. (In French). (CONF-730983-13). Dep. NTIS (US Sales Only) $4.00.

From congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

The development of the fast neutron reactor in France and other countries is compared to the development of light water and high temperature reactors. The various stages of acquisition of knowledge are discussed, and the present position in France is appraised: the demonstration Phenix plant will soon be completed; and the prototype 1200 MW(e) Super Phenix is on the drawing boards. The main choices adopted in the French programme are described. (auth)

5210 (CEA-CONF-2647) ULTRASONIC VISUALIZATION IN SODIUM SYSTEM (VISUS) AND ACOUSTIC DETECTION IN THE FAST REACTOR PHENIX. Lions, N.; Baron, J.; Buis, H.; Berger, R.; Bret, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France); Societe d'Etudes Techniques et d'Entreprises Generales (SODETEG), 92 - Plessis-Robinson (France)). 1973. 18p. (In French). (CONF-730983-17). Dep. NTIS (US Sales Only) $4.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

Two acoustic instruments, developed at the fast neutron department of the CEN/CADARACHE, will be presented. They are in use as part of the instrumentation of the reactor PHENIX. The first one is of the active type, the second of the passive type. The active instrument operates like a SONAR and visualises objects which are in the reactor vessel, in particular the fuel assembly beads during handling operations. The passive instrument, the acoustic detector, supervises the reactor core by analyzing the acoustic noise produced in the reactor core. The electro-acoustic converters are, in both cases, situated outside the reactor. The acoustic vibrations are conducted by means of wave-guides. Both instruments are designed to operate in a hostile medium, high temperature liquid metal, high neutron flux and strong gamma field. (FR)

5211 (CEA-CONF-2658) PHENIX CORE: DESCRIPTION AND FIRST OBSERVATIONS MADE DURING POWER SET-UP. Estavoyer; Ginier; Marmonier; Skok; Pontier; Clottes; Marcon. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). [nd]. 15p. (CONF-740318-6). Dep. NTIS (US Sales Only) $4.00.

From conference on fast reactor power stations; London, UK (11 Mar 1974).

Following a description of the PHENIX equilibrium core, the PHENIX subassemblies and the thermal, hydraulic and mechanical problems arising in connection with them are described. A description of the major experimental devices and special subassemblies used for the approach to criticality and the power set-up precedes an account of the initial results of some experiments made on the start-up core. Pressure measurements made in the subassembly support grid and preliminary core thermal balance at 380 MW(*t*) are reported. (auth)

5212 (CEA-CONF-2659) PHENIX DYNAMIC BEHAVIOR AND CONTROL. Acket; Chaumont; Decuyper; Jallade; Ladet; Martin. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). [nd]. 7p. (CONF-740318-3). Dep. NTIS (US Sales Only) $4.00.

From conference on fast reactor power stations; London, UK (11 Mar 1974).

Dynamic studies have been performed since the early design period of Phenix; these studies have been pursued in order to specify the normal start-up and shut-down procedures; to ensure that various incidents (scram, pump disconnection,...) do not harm either the reactor or the core components; and to fix the various safety thresholds. In all these studies various models have been used to simulate the plant and one of the purposes of many experiments performed during the power increase was to confront the theoretical models with the experimental results; this confrontation is still being pursued and will require some time before being completed; however, from the results so far obtained, it can be concluded that the overall behavior of Phenix was correctly predicted. (auth)

5213 (CEA-CONF-2660) EXPERIMENTAL PHYSICS RESULTS AT THE START UP OF PHENIX. Clauzon; Coulon; Gourdon; Gouriou; Humbert; Martin; Mougniot; Sicard. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). [nd]. 15p. (CONF-740318-5). Dep. NTIS (US Sales Only) $4.00.

From conference on fast reactor power stations; London, UK (11 Mar 1974).

The zero power physical measurements made on PHENIX during the power rise were intended to determine the neutron and thermal parameters of the reactor core, initially for adjusting the monitoring instruments and subsequently for the operation of the power station. The time required for specific zero-power testing was hardly more than one month - a relatively short time for a prototype nuclear power-station. Furthermore, this specific testing period was used to maximum advantage, as the operating conditions were suited to obtaining the best possible results. Once the circuits are working under normal conditions, we are no longer dealing with a reactor but rather with a power station. The operating procedures are then dictated by the sodium-vapor conditions and it becomes difficult to separate the various parameters - such as, for example, those affecting reactivity: temperature, flow rate, power. It then becomes necessary to collect a maximum of data (and therefore to develop the means required for recording them) in order to distinguish each of these parameters individually. This is proposed for the final phase of the power rise and during the first operating cycles. (auth)

5214 (CEA-CONF-2661) SODIUM ANALYSIS AND PURIFICATION, AEROSOLS TRAPPING IN PHENIX REACTOR. Boutrais, M.; Champeix, L.; Chouard, P.; Dolias, M.; Tibi, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). [nd]. 21p. (CONF-740318-4). Dep. NTIS (US Sales Only) $4.25.

From conference on fast reactor power stations; London, UK (11 Mar 1974).

The sodium sampling and purification system of the PHENIX reactor is described. Observations made before and during reactor startup are discussed. The methods of analysis and some of the results obtained are reviewed. The trapping of sodium aerosols from the cover gas is examined. (JWR)

5215 (CEA-CONF-2666) STEAM GENERATOR DEVELOPMENT FOR SUPER PHENIX PROJECT. Robin, M. G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1974. 29p. (In French). (CONF-740327-2). Dep. NTIS (US Sales Only) $4.50.

From 19th nuclear congress meeting; Rome, Italy (21 Mar 1974).

The development program of steam generators studied by Babcock Atlantique and Stein Industrie Companies, jointly with CEA and EDF, for the Super Phenix 1200 MWe Fast Breeder Power Plant, is presented. The main characteristics of both sodium heated steam generators are emphasized and the experimental studies related to their key features are reported. (auth)

5216 (CONF-740903-13) ORNL LMFBR EXPERIMENTAL SHIELDING PROGRAM. Clifford, C. E. (Oak Ridge National Lab., Tenn. (USA)). 1974. 14p. Dep. NTIS $4.00.

From meeting on advanced reactors; physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

An ORNL experimental program supporting the development of LMFBR shield design methods has over the past five years included investigations of the fast neutron fluxes incident on the FFTF grid plate, the penetration of neutrons through very large thicknesses of sodium and iron, the streaming of neutrons in sodium gaps between iron-pin arrays, the production of secondary gamma rays in an iron slab simulating the FFTF top head, the streaming of neutrons around sodium coolant pipes, and the attenuating characteristics of various shields designed by General Electric, Westinghouse, and Atomics International. These experiments and their accompanying analyses not only have directly influenced some current shield designs, but have also prompted specific improvements in the radiation-transport calculational methods, as well as re-evaluations of some cross-section sets. The result is an increasing confidence in the combined experimental and analytical approach for developing accurate shield design techniques. (auth)

5217 (GA-A-13095) USE OF 1DFX RESULTS IN CYLINDRICAL GEOMETRY AS A SURFACE SOURCE FOR 1DFX CALCULATIONS IN SLAB GEOMETRY. Rouse, C. A.; Mathews, D. (General Atomic Co., San Diego, Calif. (USA)). 22 Aug 1974. Contract AT(04-3)-167. 29p. Dep. NTIS $4.00.

A method is developed for using the 1DFX S_n transport code results that are obtained from a solution in cylindrical geometry as a surface source for 1DFX calculations in slab geometry. The method involves calculating the weighted means of the cylindrical fluxes for forward directions with the same direction cosines and using this mean flux as the input for the corresponding slab angular flux with the equivalent direction cosine. The accuracy of the method is demonstrated by calculating slab surface sources from a cylindrical solution at two points in the 300-MW(e) GCFR blanket. The resultant 10-group slab fluxes in the source interval are shown to differ by 2% or less from the corresponding cylindrical fluxes, indicating an accurate transition. It is concluded that completely symmetric quadrature sets are necessary for the accurate transition between slab, cylindrical, and spherical 1DFX or any one-dimensional discrete ordinate solutions. It is also concluded that such quadrature sets are also necessary for accurate transitions between two-dimensional and one-dimensional discrete ordinate calculations. (4 references) (auth)

5218 (GEAP-13771-11) NUCLEAR DESIGN AND SHIELDING. Eleventh Quarterly Report, April—June 1974. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Jul 1974. Contract AT(04-3)-893. vp. AT.

Current activities and technical progress are reported for four subtasks. Subtask A covers the post-analysis of the Demonstration Plant Benchmark Critical Experiments in ZPPR-3 and the technical direction and analysis of similar experiments in ZPPR-4. Subtask B is directed toward the development of the calculational methods that can be used at the sites of the Demonstration and later LMFBR Plants to determine the reactor power distribution, reactivity and fuel status, and for consideration of alternate fuel and control management schemes. Subtask C is in support of the nuclear data evaluation and testing efforts and methods development for the national LMFBR program. Subtask D progress is reported for the pre-measurement analysis of selected LMFBR shielding experiments. These experiments will be completed at ORNL's Tower Shielding Facility during FY-75. (auth)

5219 (HEDL-TME-74-2(Vol. 4)) HEDL QUARTERLY TECHNICAL REPORT, APRIL, MAY, JUNE 1974. Volume 4. Engineering and Development. Noordhoff, B. H.; Weber, S. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1974. Contract AT(45-1)-2170. 72p. AT.

Information is presented concerning the testing of Clinch River Breeder Reactor and FFTF components and systems, nondestructive testing engineering, development of FFTF instrumentation and data processing systems, and development of a neutron radiography facility for the examination of FFTF fuels and components. (DCC)

5220 (JAPFNR-157) DETERMINATION OF ISOTOPE RATIO OF TRACE AMOUNTS OF RARE GASES IN ARGON GAS. Tokita, M.; Takani, S.; Atsumo, H. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). May 1974. 49p. (PNC-N-951-74-05). Dep. NTIS (US Sales Only) $5.50.

A mass-spectrographic method was studied for determination of isotope ratio of trace amounts of rare gases in argon gas, and the operating conditions of mass spectrometer such as ionic potential, total emission current, mass resolution factor, and pressure of sample gas were decided. Trace amounts of 0.08 ppm of Ne, Kr and Xe in argon gas are detectable by this method. Coefficient variation of the determination of isotope ratio is 8% at 0.08 ppm level, 6% at 1 ppm level and 3% at 10 ppm level of the concentration of rare gases in Ar gas, respectively. From the investigations, however, it was found that diatomic ion Ar_2^+ overlapped the mass peak of ^{78}Kr(M/e 78) and ^{80}Kr(M/e 80), and the mass peak of ^{20}Ne overlapped the divalent ion of Ar(M/e 20). Therefore, in the case of the determination of ^{87}Kr, ^{80}Kr, and ^{20}Ne isotope ratio, it was found that preliminary separation of the rare gases from the Ar or substitution of Ar by He gas is necessary. The system is being developed for failed fuel element detection at the JOYO reactor. Each fuel element is filled with different tagged gas so that the position of the failed element can be determined by the mass spectroscopic identification of the tagged gas. (WHK)

5221 (JAPFNR-166) PROGRESS REPORT ON FAST BREEDER REACTOR DEVELOPMENT IN JAPAN, JANUARY—MARCH 1974. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Jul 1974. 6p. (PNC-N-251-74-12). Dep. NTIS (US Sales Only) $4.00.

The status of the construction of the JOYO reactor is reported. Progress in the design of the MONJU reactor is described. Research and development activities in reactor physics, components and equipment, instrumentation and control, sodium technology, steam generators, and reactor safety are summarized. (JWR)

5222 (NP-20177) ANNUAL REPORT 1972. Sodium Technology Development Program. (Nijverheidsorganisatie TNO, The Hague (Netherlands). Projectgroep Kernenergie TNO). 1973. 44p. (In Dutch).

The sodium technology development program comprises a number of separate research projects in the field of designing and testing parts and components for the prototype of the SNR 300 reactor which will be realized under the DeBeNeLux Project and situated in Kalkar (F.R. Germany). A bubble transport experiment in the sodium-filled piping of the primary coolant circuit was carried out in order to set new safety standards and the TNO patented cyclone degasser was tested to see whether it could meet the new requirements. Two new configurations were constructed to test the occurrence of vibration in bundles of both straight and spiraled pipes. The pump testing circuit was made suitable for thermal shock testing. The bearings for the sodium pump (capacity 5000 m^3 h^{-1}) tried this way. Theoretical and literature studies on heat transfer in connection with steam generators at 180 bar and relevant SNR conditions were renewed. A number of small technical innovations have been realized in the year of research and the sodium leak detection system has been improved. Extensive research was done into the corrosive effects of sodium on all exposed parts of the test circuits as well as separate samples of the steels and metals used in the construction of these circuits. Mass transport investigations of austenitic and ferritic construction steels in liquid sodium accompanied this research. All facets of mechanical testing with special attention on creep are reported. Arc welding of sodium-wetted surfaces is briefly discussed. (NL)

5223 (ORNL-4977) HIGH-TEMPERATURE STRUCTURAL DESIGN METHODS FOR LMFBR COMPONENTS. Quarterly Progress Report for Period Ending March 31, 1974. Greenstreet, W. L.; Corum, J. M.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 226p. AT.

Progress is reported in the following areas of study: (1) material behavior tests, (2) development of constitutive equations for elastic-plastic and time dependent behavior, (3) biaxiality effect in creep fatigue at elevated temperatures and creep failure under uniaxial and multiaxial conditions, (4) development, evaluation, and distribution of structural analysis methods, (5)inelastic structural tests and analyses, and (6) LMFBR component design criteria. Extensive data on Type 304 stainless steel are reported. (DG)

5224 (RD/B/N-2550) LIQUID SODIUM–HYDROGEN SYSTEM: EQUILIBRIUM AND KINETIC MEASUREMENTS IN THE 610–677K TEMPERATURE RANGE. Whittingham, A. C. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1974. 47p. (CFR/EST/P-(74)20). Dep. NTIS (US Sales Only) $5.50.

The rapid detection of sodium-water leaks in the secondary heat exchangers of an LMFBR is of critical importance in view of the severe wastage of adjacent tubes which may result from corrosion and erosion processes. Since the measurement of the hydrogen produced by the sodium-water reaction is widely used as a technique of leak detection, an understanding of the equilibrium (i.e. steady state hydrogen levels) and kinetic (rate of approach to equilibrium) behavior of the liquid sodium-hydrogen system is essential. As part of a continuing study of this system, measurements were made in an isothermal, constant volume, type 316 stainless steel reaction vessel by a technique which consisted of manometrically measuring the hydrogen absorption to equilibrium by a vigorously stirred excess of low-oxygen ($< \sim 10$ ppM) liquid sodium in the range 610-677°K. 29 references. (auth)

5225 (RD/B/N-2901) RESPONSE OF A LIQUID FILLED CYLINDER TO INTERNAL SOUND. Durrans, R. F.; Worraker, W. J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Mar 1974. 13p. (CFR/EST/P-(74) 202). Dep. NTIS (US Sales Only) $4.00.

The response of fast reactor duct-work to noise produced by the pumps is analyzed. The dynamics of a system consisting of a fixed-free cylinder enclosing a fluid are investigated. The natural frequencies are predicted successfully, the analysis showing that finite duct-work can be adequately described by an equation derived for the infinite case. An experimental investigation shows response in cylinder modes which theoretically cannot couple with the fluid resonances. It is postulated that energy flow through the base which supports the cylinder is responsible for this effect. Mechanisms of this kind are important because the response due to direct fluid-cylinder coupling is very small. 5 references. (auth)

5226 (RD/B/N-3040) PREDICTION OF LAMINAR FLOW AND HEAT TRANSFER IN A PIPE AND IN AN ABRUPT EXPANSION IN A PIPE. Durham, M. E. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jun 1974. 27p. Dep. NTIS (US Sales Only) $4.50.

The development programme for the sodium cooled fast reactor is likely to include a series of tests to investigate thermal diffusion in the coolant using water as the working fluid. If the results of these tests are to be applicable to the reactor sodium flows, then there must be thermal similarity between the sodium and water. The extent of this similarity is the subject of an experimental and numerical investigation, in which the work described is a first step. Laminar flow and heat transfer in a pipe and in an abrupt expansion in a pipe have been studied by obtaining numerical solutions to the Navier-Stokes equations. Comparison between the predictions made and data available in the literature is good. Information on the wall shear stress, and on heat transfer in an abrupt expansion is given. 12 references. (auth)

5227 DYNAMIC RESPONSE OF FAST-REACTOR CORE SUBASSEMBLIES. Belytschko, T. (Illinois Univ., Chicago (USA)); Kennedy, J. M.; Marchertas, A. H. (Argonne National Lab., Ill. (USA)). Nucl. Eng. Des.; 28: No. 1, 31-41(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1974).

A program for predicting the behavior of the hexagonal fuel assembly duct when subjected to internally generated pressures in the LMFBR is described. To a large extent, studies have been made with two-dimensional models of the hexcan. In these problems, the loadings must be restricted to line loads of sufficient length so that axial effects can be neglected. The finite element models range from a single hexcan to models which include both the loaded hexcan, two adjacent rows of hexcans, the coolant layers between hexcans, and the fuel rod assemblies. A nonlinear, transient finite element program called STRAW is used for the analyses. The program accounts for both geometric and material nonlinearities, and has special features for treating the coolant layer between hexcans by a quasi-Eulerian description and vertical flow in the hexcans and layer so that motions of the coolant can be accurately analyzed. The model has been used with loadings ranging from 500 psi to the kilobar range, and has yielded significant results on damage in adjacent assemblies and the restraining effects of the coolant. For example, preliminary results have shown that deformations of the loaded hexcan are reduced by 25 to 50% when the role of the coolant is included and that corner ductility has very large effects on hexcan response. (auth)

5228 OPTIMIZATION OF DOUBLING TIME AND DESIGN FUEL COSTS FOR FAST REACTORS BY PARTIALLY RECHARGING FUEL. Grachev, E. A.; Deinega, N. L. At. Energ. (USSR); 37: No. 3, 203-207(Sep 1974). (In Russian).

The efficiency of various techniques for partially recharging spent fuel as a means of optimizing such complex characteristics of large fast reactors as doubling time and design fuel costs has been investigated. It is shown for 1500 MW electrical capacity reactors, flattened with fuel enrichment or composition, that choosing the optimal method of partially discharging fuel significantly decreases the values of doubling time and fuel costs. The performed calculations indicate that choosing the optimal method of partially recharging exposed fuel can most significantly increase the potential of reactors flattened with fuel composition. (auth)

5229 TEMPERATURE DISTRIBUTION IN THE DUCT WALL AND AT THE EXIT OF A 19-ROD SIMULATED LMFBR FUEL ASSEMBLY (FFM BUNDLE 2A). Fontana, M. H.; MacPherson, R. E.; Gnadt, P. A.; Parsly, L. F.; Wantland, J. L. (Oak Ridge National Lab., TN). Nucl. Technol.; 24: No. 2, 176-200(Nov 1974).

Experiments were performed with a 19-rod test assembly in the fuel failure mockup sodium loop in which fuel rods were simulated by electrical cartridge heaters having the same external configuration, spacer arrangement, temperature, and heat flux as those of a typical liquid-metal fast breeder reactor (LMFBR). Temperatures were measured within the rod bundle, at the exit, and along the duct walls of the rod assembly for widely varying conditions of flow and power density and for nonuniform radial power distribution. Significant differences in temperature were measured around the duct periphery. These appeared to be linearly dependent on the power density. Flow reduction caused a decrease in these measured temperature differences. Temperatures at the exit of interior subchannels agreed with analytical predictions. Those of peripheral channels, however, indicated the existence of significant swirl flow around the rod bundle and required a separate analytical treatment. In situ radiographs indicated distortion of the rod bundle toward the duct wall at elevations where the spiral wire-wrap spacers did not touch the duct wall. At each elevation, the measured circumferential temperature profile was related to the position of the wire-wrap spacers relative to the duct wall. Higher temperatures were measured on duct walls not in contact with the spacers. The measured differences in temperature around the duct periphery were of sufficient magnitude that, if present in LMFBR cores, their effect should be considered in evaluating temperature-dependent material growth due to fast-neutron irradiation. (auth)

5230 ORRIBLE: A COMPUTER PROGRAM FOR FLOW AND TEMPERATURE DISTRIBUTION IN 19-ROD LMFBR FUEL SUBASSEMBLIES. Wantland, J. L. (Oak Ridge National Lab., TN). Nucl. Technol.; 24: No. 2, 168-175(Nov 1974).

The ORRIBLE computer program was written to predict the flow and temperature distribution for steady single-phase flow through a bundle of 19 heated rods spaced by helical wire wraps in a hexagonal duct. Any combination of flow subchannels can be blocked at the inlet. The section can have an unheated entrance length followed by a heated section and an unheated exit length. In the heated section, the linear heat rate of each of the rods can be individually specified. Turbulent interaction, sweeping crossflow due to the wire wrap, and transverse thermal conduction are considered. An approximate relationship for pressure-diversion crossflow in terms of local axial mass velocities is used to eliminate pressure as a variable. Hence, the computational procedure does not require iterative techniques. (auth)

5231 GAS TAG IDENTIFICATION OF FAILED FUEL. I. Synergistic Use of Inert Gases. McCormick, N. J.; Schenter, R. E. (Hanford Engineering Development Lab., Richland, WA). Contract AT(45-1)-2170. Nucl. Technol.; 24: No. 2, 149-155 (Nov 1974).

Gas tagging consists of the addition to nuclear reactor fuel pins of small amounts of gas having a unique isotopic composition for each assembly; when an assembly fails during subsequent irradiation, the tag gas, which is released along with the fission gas, makes it possible to locate the defective assembly by a mass spectrometric analysis of the reactor cover gas. The usual gas tagging scheme employs only xenon; calculations are presented here which have led to the synergistic use of xenon and krypton for the fast flux test facility (FFTF) reactor. The ratios of the tag gas isotopic concentrations have been obtained for a preliminary design for the FFTF. (auth)

5232 GAS TAG IDENTIFICATION OF FAILED FUEL. II. Resolution Between Single and Multiple Failures. McCormick, N. J. (Hanford Engineering Development Lab., Richland, WA). Nucl. Technol.; 24: No. 2, 156-167(Nov 1974).

Gas tagging consists of the addition to nuclear reactor fuel pins of small amounts of gas having a unique isotopic composition for each assembly; when an assembly fails during subsequent irradiation, the tag gas which is released along with the fission gas, makes it possible to locate the defective assembly by a mass spectrometric analysis of the reactor cover gas. Location of the ratios of the tag gas isotopic concentrations on curved surfaces in a three-dimensional tag-ratio space enables the three ratios corresponding to failure of a single fuel assembly to be distinguished from those formed from any combination of two or more failed assemblies. Three prototypic designs have been analyzed for the fast flux test facility (FFTF) reactor, and some alternative design possibilities have been suggested. Based upon these results, current FFTF gas tag designs incorporate to a certain extent the principle of curved surfaces. (auth)

5233 SENSITIVITY OF FAST REACTOR STATIC AND DYNAMIC PARAMETERS TO DIFFERENT FISSION-PRODUCT CROSS-SECTION DATA. Ilberg, D.; Saphier, D.; Yiftah, S. (Soreq Nuclear Research Centre, Yavne, Israel). Nucl. Technol.; 24: No. 2, 111-122(Nov 1974).

Fast reactor static and dynamic parameters of "clean" and 100,000 MWd/MT cores were evaluated. The calculations were performed with five different fission-product cross-section sets (FPCS). The following results were obtained: (1) the k_{eff} is reduced by up to 10% after burnup of 100,000 MWd/MT; however, only small differences were found when using different FPCS, (2) the positive sodium void effect is doubled, and up to 50% differences are observed when using different FPCS, (3) minor differences in plutonium isotopic concentration were found after burnup of 100,000 MWd/MT when using different FPCS in the calculations, (4) the effective delayed-neutron fraction, β_{eff}, is changed considerably during the burnup process, but only small differences were observed when β_{eff} was calculated with different FPCS, (5) the prompt-neutron lifetime, l_{eff}, may change by 10%; it is affected by using different FPCS, and (6) the spatio-temporal behavior of a high-burnup reactor undergoing a local step perturbation differs by several orders of magnitude from the "clean" reactor, and significant differences were obtained between transient solutions using different FPCS. (auth)

5234 THEORETICAL AND EXPERIMENTAL STUDY OF PHENIX STEAM GENERATOR PROTOTYPE MODULES. Duchatelle, L.; de Nucheze, L.; Robin, M. G. (CEA, Gif-sur-Yvette, France). Nucl. Technol.; 24: No. 2, 123-136(Nov 1974).

Prior to construction, the modular steam generator of the French 250-MW(e) fast breeder demonstration plant (Phenix) was subjected to a number of tests carried out on full scale module mockups. The Phenix steam generator consists of seven tube coil-shaped modules operated as countercurrent sodium-to-water (or steam) heat exchangers. A report is presented on the experimental verification of the accuracy of the procedures and models utilized to predict the steady-state heat transfer, the pressure losses, and the static stability of a 15-MW(t) mockup comprised of an economizer-evaporator, a superheater, and a reheater tested for 8000 h on the 5-MW(t) CEA facility at Grand Quevilly, and a 45-MW(t) mockup comprised of three economizer-evaporators, three superheaters, and three reheaters tested 6200 h at Les Renardières on the 45-MW(t) EDF facility. (auth)

5235 METHOD FOR THE DISTINCTION BETWEEN FUEL ELEMENTS AND/OR BREEDING ELEMENTS INTENDED FOR OR INSERTED IN A NUCLEAR REACTOR. Overhoff, T.; Stupp, H. J. (to Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). German Patent 2158572/S/. 7 Jun 1973. 9p. (In German).

3 figs.

The process deals with elements in which the fuel or breeder material are present in a graphite matrix or cladding, so that small amounts of chemical elements can be introduced into the carbon of the cladding and be spectroscopically determined. Before inserting the fuel or breeder elements into the reactor, slightly diffusing chemical elements not influencing, or only to a disappearingly slight extent, the neutron flux of the reactor, and which can be excited by a laser pulse, are introduced into the carbon in the cladding in such concentrations that the macroscopic neutron-capture cross-section remains small. The fuel elements or breeder elements are then irradiated by means of laser pulses in such a manner that the thus forming plasma focus lies in the beam path of a known suitable apparatus for spectral analysis. Beryllium, aluminum, titanium, yttrium and zirconium are used as elements. Furthermore, the process of the insertion of the chemical elements is described. (GE)

5236 NUCLEAR REACTOR. Garkisch, H. D.; Yant, H. W.; Patterson, J. F. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). German Patent 2256645/A/. 5 Jul 1973. 25p. (In German).

3 figs.

The described reactor contains elongated fuel elements which are supported by an upper and a lower supporting plate. The displacement of the reactor core as a result of thermal bending as well as nuclear-induced swelling and creep strain is limited by a radially arranged support construction. This construction is held in position by spacers and spring components. (GE)

Research, Test, and Experimental Reactors

Refer also to abstracts 3970, 5166, 5216, 5219, 5265, 5267, and 5356.

5237 (AEC-tr-7583) RESULTS OF WORK ON THERMO-EMISSION CONVERSION IN THE USSR IN 1973. Sep 1974. Translated by W. J. Grimes from Report to the Ninth Meeting of the International Liaison Group on TEC. 9p. Dep. NTIS $4.00.

5238 (EURFNR-1170) MEASUREMENT OF THE β_{eff} OF THE SNEAK-7A AND 7B ASSEMBLIES AND MASURCA R2 BY THE FREQUENCY ANALYSIS OF REACTOR NOISE. Vaeth, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Feb 1974. Translation of KFK-1883. 15p. Dep. NTIS (US Sales Only) $4.00.

Work Performed Under United States-Euratom Fast Reactor Exchange Program.

One possible reason for the discrepancy between the calculated and measured reactivity values of the core material of a fast plutonium reactor is an incorrect calculation of the effective fraction of delayed neutrons. To clarify this question, experimental determinations of the β_{eff} value have been determined on the plutonium assemblies SNEAK-7A and 7B and on the uranium core Masurca R2 (CEN, Cadarache). The methods for the determination of the β_{eff} value include also the analysis of reactor noise. All noise methods yield the decay constant α of the prompt neutron flux and the product $\beta^2_{eff} \cdot F$. If the value for β_{eff} is required, the total fission rate F in the reactor has to be determined by another independent method. The frequency analysis of reactor noise and the measurement of β_{eff} on the above assemblies is discussed. (auth)

5239 (EURFNR-1193) PHYSICS INVESTIGATIONS OF TWO Pu-FUELED FAST CRITICAL ASSEMBLIES: SNEAK-7A and 7B. Fischer, E. A.; McGrath, P. E. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Mar 1974. 93p. (KFK-1939). Dep. NTIS (US Sales Only) $5.45.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Two Pu-fueled fast critical assemblies of different enrichment were studied in the Karlsruhe Fast Critical Facility SNEAK for the purpose of testing cross section data and calculational methods. Measurements of the normalization integral and β_{eff} were performed to investigate the discrepancy in the reactivity scale of fast reactors. Measurements of the core material buckling were also included. The measurement procedures employed are described in some detail. The evaluation of the data was performed with the most recent cross section sets and computer codes available at Karlsruhe. Some of the evaluations were also performed with a cross section set based on ENDF/B data. (auth)

5240 (HEDL-TME-74-32) CONTROL ROD LIFETIMES IN THE FTR: LIMITS DUE TO BOWING. Christensen, J. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1974. Contract AT(45-1)-2170. 45p. AT.

Control rod life limits, arising from steel swelling and thermal gradient-induced duct bowing and the resulting mechanical interaction between movable and fixed components, were determined by using the CRASIB code. Methods for extending lifetimes, including element shortening through venting, revised design philosophies, and various possible mechanical modifications, were evaluated. Development activities required for optimizing control element performance and improving behavior prediction accuracy were identified and evaluated in terms of expected lifetime improvement. (auth)

5241 (HEDL-TME-74-48) FATIGUE-CRACK PROPAGATION BEHAVIOR OF FTR OUTLET PIPING MATERIAL AT 1000°F. James, L. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1974. Contract AT(45-1)-2170. 20p. AT.

The fatigue-crack growth behavior of FTR primary piping outlet material was characterized at 1000°F (538°C) using linear-elastic fracture mechanics techniques. Specimens representing both axial and circumferential cracks were tested, and specimens were studied that had received 0, 3000 and 6000 Hr. exposure at 1000°F prior to testing. No significant effect of either crack orientation or thermal aging was noted. These results were compared to similar tests on another heat of Type 316 stainless steel (not FTR material), and no heat-to-heat differences were apparent. Same previously unpublished data on frequency effects on the second heat of Type 316 stainless steel are also presented. (auth)

5242 (HMI-B-155) START-UP OF THE RESEARCH REACTOR BER II WITH UZrH FUEL ELEMENTS. Buchholz, H.; Fischer, C. O.; Wasserroth, K. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)). Jun 1974. 58p. (In German). Dep. NTIS (US Sales Only) $6.00.

5243 (IRI-Int-131-73-02) ADDITIONAL DESCRIPTION OF THE INSTALLATIONS OF THE HOR REACTOR AT DELFT. Rijks, H. J. (Interuniversitair Reactor Instituut, Delft (Netherlands)). Apr 1973. 12p. (In Dutch).

The power of the HOR reactor has been raised from 2MW to 3MW by the introduction of a different type of fuel element. Specifications of these fuel elements are given. In relation to the raising of the power the so-called nitrogen-16 measuring channel has been installed whereby the safety of the reactor is increased. The nitrogen-16 measuring channel enables a more accurate determination of the power of the reactor and the observation of its behaviour during the nuclear cycle. A stainless steel cladding has been applied to the concrete walls of the reactor tank, to prevent leakage of water. Extra alarms were added to the reactor protection system and necessary reactor channels were constructed. (NL)

5244 (JAERI-M-5537) TRIAL IRRADIATION IN JMTR. 2. Fuel Irradiation. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 299p. (In Japanese). NTIS (US sales Only).

Fuel irradiation experiments were made during trial operation of the JMTR. Irradiation capsules, capsule temperature-profiles, irradiation experiments and analysis of the post-irradiation results are described. (DG)

5245 (JAERI-M-5648) TRIAL IRRADIATION IN JMTR. 4. Zirconium and Other Materials. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 110p. (In Japanese). NTIS (US Sales Only).

The results of post-irradiation examinations of zirconium alloys and other reactor materials irradiated during the test operation of JMTR are described. The following materials were tested: zircaloy-2 and zircaloy-4 cladding specimens, Be-Ca fuel cladding and reflector alloys; Be-Ce, Be-Cu, Be-Cr, Be-Mo, Be-Ni, Be-Ti, Be-V, Be-Y, and Be-Zr alloys; stainless steel with 1 wt.% boron, aluminium-boron alloy, stainless steel-clad B_4C, silver-indium-cadmium alloy, and rare-earth oxides (Sm_2O_3, Eu_2O_3, and Gd_2O_3, each 10 wt.%) dispersed in stainless steel; V-Ti alloy and Nb-V and Nb-Zr alloys. (DG)

5246 (JUL-1075-FF) BEAM QUALITY AND OPERATING BEHAVIOR OF COLD NEUTRON SOURCES WITH THE NEUTRON GUIDE AT THE FRJ-2 (DIDO) RESEARCH REACTOR. Bauer, G.; Zinken, A.; Tholen, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). May 1974. 57p. (In German). Dep. NTIS (US Sales Only) $6.00.

The thermodynamic state of a cold neutron source can be modified by variation of the operational pressure, temperature, and moderator mixture. The temperature of the coolant gases, the pressure in the equalization chamber, and the composition of the moderator mixture (H_2/D_2) in the cold source of the FRJ2-DIDO were systematically varied. The effect of the individual operational values (gain factors) on the beam intensity in the wavelength region from 2 to 12 Å was studied with a time-of-flight analysis of the neutrons. The results were given as relative values. It could be shown that the cold source in operation with pure H_2 is overmoderated, that is that the layer thickness if larger than the optimum layer thickness and therefore the absorption of H_2 is overbalanced. A reduction of the effective layer thickness by increase of the bubble fraction at higher temperature of the coolant gases leads to an increase of the neutron yield. A dependence on the pressure in the equalization chamber was found only to the extent that temperature changes of the coolant gases less strongly affect the neutron yield at higher pressures. By mixing weakly absorbing D_2 to the H_2 of the moderator an optimization of the neutron yield can be obtained. As a result of the series of studies with varying mixing ratios, the following can be given as optimum for the operational values: moderator mixture of 80% H_2 and 20% D_2, coolant gas temperature of 14.5°K, and pressure of 2.5 atm. in the equalization chamber. A maximum value of about 20 was found for the gain factor at a neutron wavelength of 8 Å. At longer wavelengths about 10 Å there is a sharp decrease of the gain factor whose origin is still unknown. In addition to studies on the cold source data were processed on additional beam tube units: transmission of the Bi filter in cooled and uncooled states, attenuation of the beam by the monochromatic crystals installed, and the absolute intensities at various sites of the neutron guide gap determined with gold probe activation. (tr-auth)

5247 (KFKI-74-29) RECONSTRUCTION OF THE BUDAPEST RESEARCH REACTOR WWR-C. Szabo, F.; Varkonyi, L.; Frankl, L.; Vizdosh, G.; Tot, M.; Balog, Sh.; Pallagi, D.; Tsiko, R. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 48p. (In Russian). Dep. NTIS (US Sales Only) $5.50.

The justification and the purpose of the reconstruction of the WWR-S type reactor of Budapest are given. The parameters of the operating core-configuration developed at the critical assembly ZR-3 are briefly discussed. The technical-engineering works accomplished during the reconstruction are dealt with in detail and the results of the measurements carried out at the reconstructed reactor are given. 6 references. (auth)

5248 SLA-73-1017) ANNULAR CORE PULSE REACTOR (ACPR): EXPERIMENTER'S MANUAL. Bonzon, L. L.; Morris, F. M.; Thome, F. V. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 57p. Dep. NTIS $6.25.

ACPR operational characteristics and procedures for experimenters are summarized. Emphasis is on the user's needs regarding facility access and in estimating total exposure to the experiment. This document replaces Sandia Laboratories publication SC-M-68-454, "Annular Core Pulse Reactor Experimenter's Manual" as the applicable manual for ACPR. 13 references. (auth)

5249 PROGRAM OF IN-CORE MEASUREMENTS. II. Irradiation Experiment with Special Fuel Assemblies. Krett, V.; Kott, J.; Vlcek, J.; Smolik, J.; Velechovsky, V.; Horcicka, J.; Majer, J.; Krettova, A.; Nemec, J.; Cerny, K.; Jirousek, V.; Sibra, J.; Stepanek, K.; Sokol, J.; Slauf, F.; Teren, S. (Skoda, Plzen, Czech.). Jad. Energ.; 20: No. 9, 289-297(Sep 1974). (In Czech).

A description of a special integral-type model of a fuel assembly with in-core instrumentation as used in the VVR-S reactor gas loop experimental channel (Nuclear Research Institute, Rež) is presented, and the results obtained in experimental irradiation of sensors and other modal parts of assemblies intended for determining irradiation-induced heating of uranium, and for the measurement of temperatures and throughflow in the A-1 reactor core are discussed. (auth)

5250 NEUHERBERG RESEARCH REACTOR. Rau, G. (Physikalisch-Technische Abteilung, Neuherberg, Ger.). pp 295-296 of Umweltschutz bei Nuklearer und Konventioneller Energiegewinnung. Braun, H. (ed.). Stuttgart; Geog Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

The neuherberg research reactor is a zirconium hydride, light water moderated swimming pool reactor. Its three types of operations are described. The irradiation devices available are discussed. (JSR)

5251 NONDESTRUCTIVE BURNUP DETERMINATION BY GAMMA-RAY SPECTROSCOPY. Tzou, C. K.; Yang, C. M. (National Tsin Hua Univ., Hsichu, Taiwan). Nucl. Technol.; 24: No. 2, 246-251(Nov 1974).

A cold fuel assay method has been developed for nondestructive burnup determination by gamma-ray spectroscopy. This method utilizes the product of neutron flux and time as one variable to avoid tedious treatment of neutron flux, resident time, and intermittent type of iteration. No chemical or mass spectroscopic analysis is needed; only the photopeak of ^{137}Cs needs to be analyzed. The method has been applied to fuel element No. 25 of the THOR reactor for burnup calculation. A 35-cm^3 Ge(Li) detector connected to a 1024 MCA was used. (auth)

5252 TEST LOOP FOR NUCLEAR REACTORS. Deckers, H.; Reiser, H. (to Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F. R. Germany)). German Patent 2200581/A/. 12 Jul 1973. 15p. (In German).
3 figs.

The test loop consists of an external, vertical pressure tube and a coaxially positioned tube-shaped irradiation device, spaced from the pressure tube and which can be removed from the top. On the lower end of the device which conducts the cooling medium, there is the test element to be cooled. There are also inlet and outlet ducts for the cooling medium which lie one on top of another. The technical measures to control the coolant flow in the irradiation device are described. The object of the invention is to equip the test loop in such a manner that, during changing and transporting of the irradiation device as well as with a failure of the cooling during operation, cooling medium can be delivered to and taken off from the test fuel rod bundle fast and safely to remove the after-heat independent of the main cooling system. (GE)

5253 NUCLEAR REACTOR. Deckers, H.; Fischer, M.; Hitzschke, U.; Mueller, A.; Reiser, H.; Class, G. (to Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F. R. Germany)). German Patent 2165909/A/. 12 Jul 1973. 13p. (In German).
3 figs.

A fast high-flux test reactor is described where the emphasis is on the position and arrangement of the operating devices. The operating room is divided into at least two subspaces which are arranged over the reactor lid at different levels and are separated from each other in a gas-tight manner. The operating devices over the reactor lid share their functioning of both subspaces. The operating room which is immediately over the reactor lid is designed as a hot cell. (GE)

5254 FUEL IRRADIATION CAPSULES AND CAPSULE FABRICATION AND ASSEMBLY TECHNIQUES AT THE FR2. Haefner, H. E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung); Sebold, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Reaktorbetrieb und Technik). Kerntechnik; 16: No. 8/9, 393-400(Sep 1974). (In German, English).
4 figs.; 10 refs.

An irradiation program has been running for some 10 years at the Karlsruhe research reactor FR2 in connection with a fuel element development program for the Fast Breeder Project. This program entails several experiment groups with various objectives. The several special incore irradiation facilities which have been developed and built in this connection over the years are described. These descriptions are chiefly concerned with fabrication and assembly techniques. (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 5166, 5266, and 5415.

5255 (UNI-251) EVALUATION OF WEATHERED IMPREGNATED CHARCOALS FOR RETENTION OF IODINE AND METHYL IODIDE. Bennett, E. C.; Strege, D. E. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 8 Aug 1974. Contract AT(45-1)-1857. 34p. Dep. NTIS $4.75.

A program is being performed by United Nuclear Industries, Inc. (UNI) to determine the effect of weathering and aging on the efficiency of certain impregnated charcoals in adsorbing and retaining halogens and organic halides. The end objective of this program is to establish the optimum charcoal for use in the N Reactor confinement system. After six months' exposure, samples were removed and tested for their retention efficiency. Hydrocarbon pollution compromised the methyl iodide retention capability of the test charcoals, so a second set of charcoal samples was installed in October 1972 to pursue the original objectives of the test program. The program has been expanded to include a greater range of test conditions and to evaluate newly developed charcoals, with studies scheduled to continue through FY-1975. The results of the program to date are presented. (14 references) (auth)

Propulsion and Package Reactors

Refer also to abstracts 5166 and 5237.

5256 (JNS-10) REPORT ON THE LAND CRITICALITY TEST OF A NUCLEAR REACTOR INSTALLED ON N. S. MUTSU. Shimooke, T.; Otsuka, T.; Hayashi, K.; Yamada, N.; Hayata, K. (Japan Atomic Energy Research Inst., Tokyo). Mar 1973. 147p. (In Japanese). NTIS (US Sales Only).

Design features of the Mutsu reactor are described, including the reactor control system, core configuration, instrumentation, and specifications criticality tests and measurements are described. (DG)

5257 (SNSO-3063-2) STANDARDIZATION AND ECONOMICS OF NUCLEAR SPACECRAFT. Final Report. Phase I, SENSE Study. (Fairchild Industries, Inc., Germantown, Md. (USA)). Mar 1973. Contract AT(49-15)-3063. 251p. Dep. NTIS $15.75.

Feasibility and cost benefits of nuclear-powered standardized spacecraft are investigated. The study indicates that two shuttle-launched nuclear-powered spacecraft should be able to serve the majority of unmanned NASA missions anticipated for the 1980's. The standard spacecraft include structure, thermal control, power, attitude control, some propulsion capability and tracking, telemetry, and command subsystems. One spacecraft design, powered by the radioisotope thermoelectric generator, can serve missions requiring up to 450 watts. The other spacecraft design, powered by similar nuclear heat sources in a Braytoncycle generator, can serve missions requiring up to 2000 watts. Design concepts and trade-offs are discussed. The conceptual designs selected are presented and successfully tested against a variety of missions. The thermal design is such that both spacecraft are capable of operating in any earth orbit and any orientation without modification. Three-axis stabilization is included. Several spacecraft can be stacked in the shuttle payload compartment for multi-mission launches. A reactor-powered thermoelectric generator system, operating at an electric power level of 5000 watts, is briefly studied for applicability to two test missions of diverse requirements. A cost analysis indicates that use of the two standardized spacecraft offers sizable savings in comparison with specially designed solar-powered spacecraft. (auth)

Reactor Safety and Environmental Aspects

Refer also to abstracts 3048, 3060, 3301, 3313, 3314, 3325, 3333, 3335–3346, 3350, 3351, 3353, 3354, 3356–3358, 3360–3362, 3364, 3387, and 3413.

5258 (AI-73-29) FLAME AND DETONATION INITIATION AND PROPAGATION IN VARIOUS HYDROGEN–AIR MIXTURES, WITH AND WITHOUT WATER SPRAY. Carlson, L. W.; Knight, R. M.; Henrie, J. O. (Atomics International Div., Canoga Park, Calif. (USA)). 11 May 1973. 39p.

The Atomics International Division of Rockwell International Corporation contracted with six utility companies to perform certain independent experimental studies related to the Loss-of-Coolant Accident (LOCA) postulated for light water reactors (LWR). Part of the effort involved flame and detonation initiation and propagation, which had been planned jointly with the Rocketdyne Division of Rockwell International. The results are reported. (4 references) (auth)

5259 (ANCR–1127(Rev.)) RELAP4: A COMPUTER PROGRAM FOR TRANSIENT THERMAL-HYDRAULIC ANALYSIS. Moore, K. V.; Rettig, W. H. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Dec 1973. Contract AT(10-1)-1375. 51p. Dep. NTIS $5.75.

RELAP4 is a digital computer program, written in FORTRAN IV, developed to describe the behavior of water-cooled nuclear reactors subjected to postulated transients such as those resulting from loss of coolant, pump failure, or power excursions. The program calculates fluid conditions such as flow, pressure, mass inventory, and quality; thermal conditions such as surface temperatures, temperature profiles, and energy distributions; and heat fluxes in power generating and dissipating elements. The program also calculates reactor power, decay heat, and reactivity. In addition to describing transients in boiling-water and pressurized-water reactors, the program is sufficiently versatile to describe transients in experimental thermal-hydraulic systems. The RELAP4 user must define the geometric features of the system to be analyzed as well as an appropriate set of initial conditions. RELAP4 then solves an integral form of the fluid conservation and state equations applied to each user-defined control volume. Currently, the number of these control volumes is limited to 75 and the number of junctions (flow paths) between volumes is limited to 100. By simply increasing the array sizes, these limits could be raised, if necessary, until the capacity of the particular computer is reached. RELAP4 source decks are available in double precision (EBCDIC) versions. Special timing and input-output routines are available and used by the RELAP4 program for the IBM 360 systems. Some of these routines are necessary and, if other computers are used, must be rewritten for those computers. Sample problems have been run on the IBM 360/75 computer. (auth)

5260 (ANL-8129) HEAT LOSS TO COLD STRUCTURE DURING A FUEL-COOLANT INTERACTION. Chen, W. L.; Cho, D. H. (Argonne National Lab., Ill. (USA)). Sep 1974. Contract W-31-109-Eng-38. 19p. AT.

Two heat-loss formulations have been developed to take into account energy losses from the fuel-coolant interaction zone. The first formulation concerns the heat loss from the interacting sodium to the cold cladding material initially present in the interaction zone. The second formulation deals with the heat loss that occurs as the interaction zone expands through the cold fission-gas-plenum region. The two heat-loss formulations have been incorporated into a parametric model and illustrative calculations have been performed with them. 5 references. (auth)

5261 (ANL-CT-73-15) BUBBLE FORMATION AND GROWTH. Berry, G. F. (Argonne National Lab., Ill. (USA)). Jul 1973. 21p. Dep. NTIS $4.25.

The objective of this subtask was to determine the sensitivity of various hydrogen bubble growth parameters to postulated formation conditions. This preliminary study concentrated on two aspects of the problem which could have significant impact on the formulation and numerical stability of an advanced sodium/water analysis system. These are the sensitivity of pressure and bubble radius to changes in the tube rupture model and the numerical stability of the solution to alternate assumptions concerning initial conditions for the governing differential equations. As a reference solution, the ANL effort utilized the formulation and selected results contained in Zaker and Salmon for unconstrained growth of a hemispherical bubble in incompressible sodium. After developing a numerical solution that could duplicate these results, a variable tube rupture rate was added to the model to determine its influence on the growth process. Parameter studies showed that the bubble growth is sensitive to not only the time required for tube rupture but also to the tube rupture rate. The study of alternate initial conditions for the bubble growth model has resulted in information on both the numerical stability of the solution method and on the length of time the solution is sensitive to the assumed initial conditions. For example, it was found that, for times greater than 10^{-4} seconds, the evaluation of the bubble pressure is essentially unaffected by the initial conditions. (auth)

5262 (ANL/MET-01) FUEL ELEMENT FAILURE PROPAGATION PROGRAM PLAN. Schumar, J. F.; Barts, E. W.; Carter, J. C.; Dunworth, R. J.; Ivins, R. O.; Hoglund, B. M.; Wilson, R. E. (Argonne National Lab., Ill. (USA)). Aug 1969. Contract W-31-109-eng-38. 131p. Dep. NTIS $9.75.

A research project to study the propagation of fuel-element failures, under normal and near-normal operating conditions, in liquid metal fast breeder reactors is described. The major objective of the program is to develop a predictive analytical description of fuel-element failure propagation and the consequences to the reactor system, specifically to the reactor core. Both experimental and analytical studies will be made in order to investigate the thresholds of reactor operation that cause failures to propagate, the modes of failure transport, and the consequences of failure propagation. Instrumented loops simulating near-normal operating conditions will be used to investigate the modes of failure and the subsequent events that determine the type of failure that will propagate to neighboring fuel elements. The program is divided into four mutually related and supporting details—program planning and out-of-pile, in-pile, and analytical studies. (auth)

5263 (BNWL-1848) PROBABILISTIC RISK ANALYSIS OF NUCLEAR SYSTEMS. Smith, T. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1974. Contract AT(45-1)-1830. 43p. Dep. NTIS $4.00.

Traditional "worst-case" or "maximum credible accident" methods of nuclear safety and risk analysis can be misleading. Realistic evaluation of event frequency and severity and of dispersed radionuclides requires treatment of several probability spectra. Such treatment is needed because initiating events vary in severity and releases vary in quantity and rate. The need for including probabilistic considerations in nuclear risk analyses is stressed. Although the potential application is general, certain aspects of the treatment are of special interest for transportation and waste management studies. Previous methods of quantitative risk calculation for nuclear systems are reviewed. A method of accounting for probabilistic considerations is derived, drawing from the literature review. The approach is felt to be more important than the particular equations derived. The equations could be changed to suit different requirements without sacrificing the basic intent of the method. Special effort is directed toward an approach compatible with existing fault tree and radionuclide transport methodology. Calculated accident frequencies and release quantities are weighted to give a realistic measure of risk. Frequency distributions of the most important parameters are included. Ways are discussed of simplifying the complete equations into more readily usable forms for preliminary studies. The completeness (and complexity) of the analysis can be varied to suit the required accuracy and the availability of data. (auth)

5264 (BNWL-1864) EVALUATION OF SENSORS FOR SIMULATOR ANNULUS AND RELATED MEASUREMENTS IN THE PLENUM-FILL EXPERIMENT. Section I. Preliminary Evaluation (7-1-74 to 8-20-74). Upson, U. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1974. Contract AT(45-1)-1830. 37p. Dep. NTIS $7.60.

Inspection and static testing have been performed on samples of three types of sensors and their ancillary instrumentation to determine general operability, range, output, and mechanical compatibility with the intended applications, and preliminary findings are reported herein. Dynamic testing, using air and water flows to simulate two-phase steam/water conditions, will soon be initiated. An onsite-fabricated test chamber is now on hand and is being installed, plumbed and instrumented at the test location (Building 314). This chamber will be used to test the momentum vector and hot wire instruments for transient response and for their ability to survive mechanical shock, at ambient temperatures and at low pressures. A facility for testing the float/switch and heated-thermocouple level sensors is being fabricated offsite. Following the preliminary air/water testing at this site, high pressure controlled-quality steam/water testing in the Westinghouse Canada test facilities at Hamilton (Ontario) or in the Combustion Engineering Company facility at Windsor (Connecticut) is under consideration. The results obtained to date from the "bench" tests on those sensors now on hand, with comments and suggestions relative to applicability, necessary changes, and proposed modifications are presented. The tested instruments include: 1. Float/switch liquid-level probe (PEECO); 2. Momentum vector (drag rod) flow direction probe (PEECO); 3. Discrete (single element) hot-wire phase sensor (Datametrics). The multi-element hot-wire "regime" sensors (Datametrics) have been inspected for physical condition but have not been tested. They are expected to be essentially identical to the single-element probes in their response. The heated-thermocouple liquid-level assemblies (ARI) and the void-fraction gamma absorptiometer (DD Electronics) are not yet available for testing. (auth)

5265 (CONF-740903-12) TIME-DEPENDENT REACTOR PHYSICS IN THE FFTF UNPROTECTED LOSS-OF-FLOW ACCIDENT. Smith, L. L.; Ferguson, D. R.; Cahalan, J. E. (Argonne National Lab., Ill. (USA); Purdue Univ., Lafayette, Ind. (USA)). 1974. 11p. Dep. NTIS $4.00.

From meeting on advanced reactors; physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

Four reactivity models, including the SAS3A reactivity model and the adiabatic reactivity model, are compared for different states in the FFTF unprotected loss-of-flow accident. The SAS3A reactivity for this particular accident is shown to be greater than the adiabatic reactivity and sufficiently different to alter the course of the accident. Separation of the adiabatic reactivity into material and spatial components is shown to permit time-dependent reactivity worth tables which can approximate the adiabatic reactivity for use in the SAS3A point kinetics routine. It is also noted that several reactivity effects are currently ignored in SAS3A. (10 references) (auth)

5266 (DP-1353) PERFORMANCE OF REACTOR PROCESS PUMPS WITH STARVED SUCTION CONDITIONS. Muhlbaier, D. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Jul 1974. Contract AT(07-2)-1. 33p. Dep. NTIS $4.00.

In tests with the large coolant circulation pumps in Savannah River reactors, no system damage occurred when the pumps were operated with starved suction. Pump flow was nearly constant as moderator level was lowered (suction head reduced) until air aspirated into the suction nozzle. Then the pump flow gradually decreased with further lowering of the moderator level until the suction pipe vented. Upon venting, pump flow was limited by gravity flow across the muff and suction piping. The centrifugal pumps then produced surging or pulsating flow with about a two-second cycle period. (auth)

5267 (HEDL-TME-74-31) SODIUM VOID REACTIVITY WORTH IN FTR. Harris, R. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1974. Contract AT(45-1)-2170. 37p. Dep. NTIS $4.00.

A calculational procedure to predict the reactivity effects accompanying the loss of sodium in the FFTF has been formulated and evaluated. Although it contains several significant approximations and inherent limitations, this procedure was found to adequately predict the sodium voiding experiments conducted in the FFTF Engineering Mockup Critical Assembly after a bias of −0.45 Ih/kg was applied to each calculated value. An evaluation of the differences between FFTF and FFTF-EMC and the ability of the calculational procedure to predict their effects on sodium void worth calculations indicates that similar agreement can be expected for FFTF calculations. Based on the comparison with experiment in FFTF-EMC the accuracy of the calculational procedure for FFTF is estimated to be between ±0.9 to ±1.8 Ih/kg (1032 Ih = 0.01 Δk) depending on the location of the voided regions. (auth)

5268 (HEDL-TME-74-34) SODIUM FIRE CONTROL BY SPACE ISOLATION WITH NITROGEN FLOODING-FFTF PROOF TEST F2. Hilliard, R. K.; Muhlestein, L. D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1974. Contract AT(45-1)-2170. 62p. AT.

Sodium fire protection by space isolation with nitrogen flooding was evaluated by performing a large-scale sodium fire test within a mockup of an FFTF secondary sodium system pipeway. The full scale (3350 ft^3) mockup was initially filled with air and its leak tightness set to correspond to that expected in an actual FFTF pipeway. The basis for specifying the rate of nitrogen flood gas is discussed and the experimental verification provided. Nitrogen flooding was activated 15 minutes after the spill of 770 lb of 1100°F sodium into a 32 ft^2 steel pan. The nitrogen flow was controlled manually at a constant rate of 60 ft^3/min (STP) until the pool temperature had decreased to 370°F. After cooldown, 87% of the spilled sodium remained in the unreacted form, demonstrating that sodium fires can be effectively controlled by the method of space isolation with nitrogen flooding. (auth)

5269 (KFK-1928) BEHAVIOUR OF LMFBR CORE AFTER SEVERE HYPOTHETICAL ACCIDENTS. Groetzbach, G.; Kussmaul, G.; Meyder, R.; Struwe, D. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Aug 1974. 111p. (In German). Dep. NTIS (US Sales Only) $8.50.

Considering severe hypothetical accidents of LMFBR's it is necessary to investigate the behavior of the fuel-steel masses in the reactor after such accidents. Starting from extremely conservative assumptions regarding the sequence of events the thermohydraulic behavior of the fuel-steel mixtures and molten fuel-steel configurations inside the deformed core structure is considered as well as the criticality problem. Assuming pure decay heat production it can be shown that the natural convection of the coolant in the gaps between subassemblies will be able to remove most of the heat out of the core. However, the heat produced inside the subassemblies cannot be removed to the gaps without clad and fuel melting inside the fuel-steel-mixtures. Therefore even small quantities of fuel accumulated inside a subassembly will probably melt through all of the remaining core structure and reach the bottom of the inlet pressure vessel. In order to avoid criticality for all postulated fuel-steel-configurations, one has to assume that during or after the postulated hypothetical accidents more than 50% of the fuel has to be removed from the core. The fuel particles accumulated on the grid plate can be cooled without difficulties. For the fuel mass accumulated at the bottom of the inlet pressure vessel it is shown that the thermal and hydraulic behavior of such configurations and the mechanical load of the bottom of the inlet pressure vessel under extremely high temperatures are the major problems regarding the question if a melt through of the reactor vessel has to be considered. If big masses of fuel assemble on the bottom of the inlet pressure vessel, with very simplified models final conclusions cannot be made regarding the long term integrity of the inlet pressure vessel and thus the reactor vessel. (auth)

5270 (LA-UR-74-1173) EQUATION OF STATE FOR SODIUM OVER AN EXTENDED TEMPERATURE AND DENSITY RANGE. Barnes, J. F. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 24p. (CONF-741030-1; SM-190/45). Dep. NTIS $4.25.

From symposium on thermodynamics of nuclear materials; Vienna, Austria (21 Oct 1974).

Coupled neutronics and hydrodynamic calculations of hypothetical core disruptive accidents of a liquid-metal fast breeder reactor require realistic equations of state of the relevant component materials over a very large range of temperature and density. A description is given of the methods used to construct a general equation of state for sodium that will be utilized in tabular form by a complex computer code under development at Los Alamos Scientific Laboratory for the assessment of reactor safety. The technique considers pressure to be the sum of a "cold pressure" determined by the cohesive energy of the solid and a thermal term that varies from resembling that in a solid at normal density to ideal gas behavior at low density. Since the predicted critical point data and vapor pressure as functions of temperature are in reasonable agreement with experiment, confidence is expressed in the general shape of the isotherms; calculated vapor pressures are then supplanted by experimental values. Tabular data are presented for density from 10^{-5} to 1.2 times the normal density of the solid and for temperatures from 300°K to 4000°K. (auth)

5271 (RD/B/N-2772) DRYOUT AND REWETTING IN REACTORS AND HEAT EXCHANGERS BY A THERMAL CONDUCTION ANALYSIS. Porthouse, D. T. C. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1973. 28p. Dep. NTIS (US Sales Only) $4.50.

Dryout and rewetting are of great importance in liquid-cooled reactors, both in the steady state thermal performance and in loss-of-coolant accidents. The conduction analysis, formerly applied to rewetting in emergency core cooling systems, is extended here to dryout. It is shown how this theory may be applied for the flow conditions of reactor interest, i.e., the liquid is saturated at the dryout location, no oscillations take place in the input mass flow, and the mass flow rate is high (>10 gm/cm^2). The theory is shown to be in agreement with experimental results taken from the available data, and the necessity for direct experimental work on the parameters indicated by the analysis is emphasized. It is shown that the critical heat flux is probably independent of the rod thermal properties. An appendix on heat exchanger dryout is included. 14 references. (auth)

5272 (RD/B/N-3007) ROLE OF SPONTANEOUS NUCLEATION IN THERMAL EXPLOSIONS: FREON/WATER EXPERIMENTS. Board, S. J.; Hall, R. W.; Brown, G. E. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jun 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

In experiments with Freon-22 and water small-scale explosions have been observed. High-speed film and pressure measurements have shown that the peak pressure increases rapidly with bulk water temperature but is independent of the bulk temperature of the Freon, and that there is a sharp increase in explosive yield above about 76°C. From the fact that the pressures are independent of the Freon temperature it is deduced that the instantaneous contact temperature of the bulk fluids is not critical to the explosion mechanism. The change in efficiency implied by the second result is apparent only: high-speed film, and measurements of the time between injection and explosion, show that below 76°C little Freon enters the water before the explosion occurs, while above this temperature stable film-boiling allows the whole of the Freon to penetrate the water before the explosion begins. The role of spontaneous nucleation is thus apparently to ensure the stability of film-boiling, which is important as a delaying process allowing interpenetration of the two fluids. In the case of sodium-UO_2, although stable film-boiling is unlikely, experiments in which sodium is injected into UO_2 produce vigorous explosions. It is suggested that a stabilizing shell of frozen UO_2 may develop and that this could delay the interaction in the same way as a vapor film. In some circumstances, such as a prompt-criticality incident, the fuel may be already surrounded by coolant before the excursion so that a delay is not necessary. 10 references. (auth)

5273 (SGAE-2320) SIGNIFICANCE OF CORROSION PRODUCTS IN THE PRIMARY CIRCUIT OF LIGHT WATER

REACTORS FOR RADIATION PROTECTION. Kamelander, G. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Reaktortechnik). Sep 1974. 35p. (In German). (RT—78/74). Dep. NTIS (US Sales Only) $4.75.

A summary is given of the problems of reactor safety and of radiation protection caused by corrosion products in the primary circuit. Particularly the consequences provoked by corrosion products concerning the safety of the fuel elements and concerning the doses received by the staff of a nuclear plant are presented. Furthermore, a description of experimental and theoretical methods for the investigation of these problems are given. (auth)

5274 (UNI-SA-7) PROGRESS REPORT ON SAFETY AND SECURITY OF POWER SUPPLY: NUCLEAR POWER PLANTS AND EARTHQUAKES. Davis, H. S. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 13 Aug 1974. Contract AT(45-1)-1857. 5p. (CONF-740829-1). Dep. NTIS $4.00.

From ASCE power division specialty conference; Boulder, Colorado, USA (13 Aug 1974).

The continuing need for increased accuracy, thoroughness, and completeness of earthquake engineering analysis and design standards is pointed out. Progress made in the areas of seismology, studies of dynamic structural behavior under seismic conditions, improved communication and dissemination of earthquake data and information, and adoption of seismic design criteria for nuclear power plants and components is briefly reviewed. (DG)

5275 (WCAP-8110(Suppl. 10)) TEST PLANS AND RESULTS FOR THE ICE CONDENSER SYSTEM. Static Testing of Production Ice Baskets. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). 30 Sep 1974. 26p.

A series of static loading tests have been performed on production ice baskets to determine design integrity and performance. The results of these tests are described. Six tests were used to plot ice basket failure points for different combinations horizontal distributed and vertical load. The failure curve successfully envelopes the qualification test loads. Failure occurred at a minimum of 45 percent over the minimum factor of safety based on working load is 2.7. Two tests were used to qualify the lower basket. The tests successfully enveloped the qualification test loads for those elevations which apply to the lower basket. Two tests were used to calculate the vertical spring constant of a 12 foot basket column. The ice baskets were proven to be of adequate structural strength to withstand loading limits. (auth)

5276 (WCAP-8238) PWR FLECHT-SET PHASE A REPORT. Blaisdell, J. A.; Hochreiter, L. E.; Waring, J. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1973. Contract AT(11-1)-2279. 552p. Dep. NTIS $30.75.

The results are presented of three test series: Phase A FLECHT-SET tests; low clad temperature FLECHT tests; and top injection cooling tests. The overall objective of the FLECHT-SET program is to provide experimental data on the influence of system effects on emergency core cooling (ECC) behavior during the reflood phase of a loss-of-coolant accident (LOCA). Ultimately, the test data obtained will be used to verify existing analytical techniques or serve as the basis for the development of new ones. (auth)

5277 (WCAP-8410) FLECHT-SET PHASE B SYSTEM DESIGN DESCRIPTION. Cleary, W. F.; Waring, J. P.; Rosal, E. R.; Hochreiter, L. E.; Slafka, M. J.; McQuire, M. F.; Fix, H. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). [nd]. Contract AT(11-1)-2279. 133p. Dep. NTIS $5.45.

The objective of the FLECHT-SET (Full Length Emergency Cooling Heat Transfer-System Effects Test) Program is to provide experimental data on the influence of system effects on emergency core cooling behavior during the reflood phase of a loss-of-coolant accident. Within practical limitations, the FLECHT-SET test facility response realistically preserves those system effects that are considered to be important during the reflood phase of a loss-of-coolant accident. The test facility simulates a four loop PWR in which one loop is broken and three loops are intact. The scaled simulation includes the downcomer, piping, steam generators, core and plenums. The facility preserves component elevation, flow path length and overall loop flow resistances, while properly scaling the volumes, flow areas and major heat sources. The design description of the various mechanical systems as well as the electrical data acquisition and control systems is presented. Design requirements which enable the system to realistically simulate typical PWR characteristics are included, and are discussed along with the scaling rationale. Also included is a discussion of data requirements, a test plan, and a general facility operating procedure. (auth)

5278 OPERATING TEST ON THE FLOOR DRAIN CONCENTRATOR OF THE RADWASTE TREATMENT SYSTEM FOR UNIT NO. 1 AT FUKUSHIMA NUCLEAR POWER STATION. Ariyoshi, S.; Ikeda, Y.; Aoki, K. (Ebara Mfg. Co. Ltd., Tokyo). Ebara Jiho; No. 88, 31-37(Jun 1974). (In Japanese).

The installation of floor drain concentration equipment in the radwaste treatment facility for Fuku-1 unit and the reconstruction of the treatment system including the facility for Fuku-2 unit are described. The purpose of the reconstruction was to limit to nearly zero the release of radioactivity from the nuclear power plant to unrestricted areas. It was confirmed that after the reconstruction, the new system could sufficiently treat the effluent arising from both units. The test results on the performance of the new system were quite satisfactory and provided a useful guide for planning and designing the future plant. The upper limit of ABS concentration in the influent into the radwaste treatment equipment was also determined. (auth)

5279 EXPERIMENTAL STUDY ON THE VIBRATION OF AN AGR REACTOR CORE. Yamahara, H.; Ichinose, K.; Hisatomi, Y. (Shimizu Construction Co. Ltd., Tokyo). Shimizu Kensetsu Kenkyusho-Ho; No. 21, 25-36(Oct 1973). (In Japanese).

Experiments were conducted to determine the mechanical damping constant for the reactor core of the AGR being constructed at Hunterston in the United Kingdom. The studies employed microtremors, the forced vibration by human force, and the forced vibration with a vibrator. The following facts were revealed: (1) The fundamental vibration frequency of the reactor core tends to depend on displacement amplitude. (2) The damping constant at the fundamental vibration frequency also depends on the displacement amplitude. (3) The bonding condition of neutron shielding blocks has large influence on the mode of vibration and the performance in a high frequency region, but it has little effect on the fundamental vibration frequency or the damping constant. From these results, the minimum value of attenuation constant at the fundamental vibration in the Hunterston B AGR core was determined to be 0.031, and it tends to increase with displacement amplitude. (JA)

5280 BREEDERS AS POWER REACTORS UP TO THE YEAR 2000. Haefele, W. (Kernforschungszentrum, Karlsruhe, Ger.). pp 47-58 of Umweltschutz bei Nuklearer und Konventioneller Energiegewinnung. Braun, H. (ed.). Stuttgart; Georg Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

The principle of the breeder reactor and the history of its development are briefly outlined. The economics of fast breeders and their importance are discussed. The environmental aspects of breeders and their safety are considered. (JSR)

5281 ACCIDENT RISKS IN NUCLEAR POWER PLANTS (REACTOR SAFETY). Franzen, L. F. (Institut fuer Reactorsicherheit, Cologne). pp 141-158 of Umweltschutz bei Nuklearer und Konventioneller Energiegewinnung. Braun, H. (ed.). Stuttgart; Geog Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

The risks associated with each type of energy source are tabulated, and the probabilities of fatal injuries due to various causes are compared. The danger potential of nuclear reactors is discussed. The engineering reliability and safety of reactors is considered from the viewpoints of inherent safety, quality assurance, accident prevention, and containment. The safety devices, such as the pressure vessel, emergency core cooling system, sprinkling and auxiliary systems, and the filter system, installed in every reactor are described. An analysis is made of the consequences of conceivable accidents, and the release of radioactivity occurring during recorded accidents and the results of the release are considered. (JSR)

5282 POSSIBILITIES OF NUCLEAR EMERGENCY PROTECTION (EMERGENCY PROTECTION PLAN). Pohl, W. (Bayer. Staatsministerium fuer Landesenwicklung und Umweltfragen, Munich). pp 170-179 of Umweltschutz bei Nuklearer und Konventioneller Energiegewinnung. Braun, H. (ed.). Stuttgart; Geog Thieme Verlag (1973). (In German).

From 12th annual meeting of the Association of German Radiation Protection Doctors; Munich, F. R. Germany (8 Oct 1971). See CONF-711086-.

The types of emergencies that can occur at nuclear power plants and installations can be categorized as emergencies with damage to the environment, fire, flooding and icing, and sabotage without direct effects on the environment. These can have such various origins and consequences that no plan can be devised to provide directly for each of them, but emergency plans can be provided for a series of practical possibilities. The alarm system, the controls by the operators of the nuclear installations, and the measurements and sampling to be taken following an emergency are outlined. The protective measures with respect to medical help and the population are discussed. (JSR)

5283 SAFETY FOR NO. 2 NUCLEAR POWER PLANT IN THE JAPC'S TOKAI POWER STATION. Genshiryoku Iinkai Geppo; 17: No. 12, 10-23(Dec 1972). (In Japanese).

The safety aspects of the Tokai-Mura-2 Reactor (BWR) have been examined by the committee on reactor plant safety of the AEC upon request by JAPC. The results of the examination, which confirmed its safety, are presented. The following are included: siting, the reactor plant, radiation control and exposure evaluation at normal operation, possible accidents, and evaluation of conceivable hazards. (JA)

5284 REACTOR STRUCTURAL RESPONSE TO MOLTEN FUEL-COOLANT INTERACTIONS. Bratis, J. C.; Marciniak, T. J. (Argonne National Lab., Ill. (USA)). Nucl. Eng. Des.; 27: No. 1, 1-13(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

In order to realistically determine the structural response of a liquid metal fast breeder reactor to a molten fuel-coolant interaction (MFCI), an MFCI region was incorporated into the two-dimensional, hydrodynamic containment code, REXCO-H. In this way, it is possible to account for the two-dimensional hydrodynamic response, as well as for the effect of vessels and plates, upon the expansion process in the MFCI region. The MFCI model was extended in order to increase the usefulness of the code under a variety of conditions. The sodium equation of state was improved using basic thermodynamic relations and recent data to incorporate temperature dependent properties. Heat transfer models available to describe the MFCI include not only a quasi-steady-state model, but also a parametric model, including the fuel heat of fusion. Nonhomogeneous MFCI regions can be treated by assigning different parameters to each zone within a region, including volume fractions of fuel, sodium, steel, and void, as well as initial fuel and coolant temperatures and fraction of molten fuel. Several cases were studied in order to delineate the effect of various parameters on the peak pressures generated in the MFCI zones. These include effect of initial fuel and coolant temperatures, void fraction, amount of molten fuel and/or vessel wall compliance. The response of a typical reactor configuration is evaluated for a given set of initial conditions. (auth)

5285 SEISMIC ANALYSIS OF THIN SHELL STRUCTURES. Kalnins, A. (Lehigh Univ., Bethlehem, Pa. (USA)); Godfrey, D. A. (Duke Power Co., Charlotte, N. C. (USA)). Nucl. Eng. Des.; 27: No. 1, 68-76(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

A vertically erected, axisymmetric shell, resting on a horizontal foundation is considered. The foundation is subjected to a time-dependent motion in both the vertical and horizontal directions. The motion may be produced by an event such as an earthquake or explosion. An estimate of the response of the shell to such excitation can be obtained from the solution for time-dependent boundary conditions. This solution is adapted for an analysis with the response spectrum of earthquakes, which has been pioneered by Biot and Housner. The modes of free vibration are calculated by the multisegment, direct numerical integration method using classical shell theory. An actual design case of a containment vessel of a nuclear power plant built in the US is presented. An estimate of the dynamic response of the shell to an earthquake is obtained for all the relevant variables, such as stresses and displacements. As an example, an estimate for the axial stress of the response is given at various stations of the shell. (auth)

5286 CHARACTERIZATION OF AN ENERGY SOURCE FOR MODELING HYPOTHETICAL CORE DISRUPTIVE ACCIDENTS IN NUCLEAR REACTORS. Cagliostro, D. J.; Florence, A. L.; Abrahamson, G. R. (Stanford Research Inst., Menlo Park, Calif. (USA)); Nagumo, G. (Argonne National Lab., Ill. (USA)). Nucl. Eng. Des.; 27: No. 1, 94-105(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The experimental methods for and results of determining the expansion characteristics of the detonation products of an energy source that simulates the pressure-volume change relationships for sodium vapor expansions during hypothetical core disruptive accidents in a fast test reactor are presented. Rigid cylinder-piston experiments performed at two scales (ratio 1:3) to determine a pressure-volume relationship as a function of source mass and expansion environment are described. Some of these measurements are compared with code calculations for the source. The results show: (1) that the pressure-volume relationship depends significantly on the presence of water in the cylinder and comparatively little on the timescale of the expansion, the presence of steel balls in the water, or a Mylar sheet on the water surface; and (2) the experiment's scale. A relationship between the measured work energy from the source and the charge mass is presented, and pressure-volume change measurements are compared with previous experimental measurements and with theoretical calculations for a 150 MWsec hypothetical core disruptive accident. The measurements and code calculations of the pressure-volume relationship for the source agree reasonably well. (auth)

5287 CRITERIA FOR SEISMIC ANALYSIS OF NUCLEAR PLANT STRUCTURES AND SUBSTRUCTURES. Stoykovich, M. (Gibbs and Hill, Inc., New York (USA)). Nucl. Eng. Des.; 27: No. 1, 106-120(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Criteria are presented for seismic analysis of nuclear power plant structures such as supporting structures founded on ground, as well as substructures. Nuclear power plant equipment and systems can be treated as substructures. Modeling of structures and substructures is described. Since structure response spectra play an important role in the design and analysis of nuclear power plant equipment, systems and components, methods for development of structure response spectra as well as variations of input parameters considered in determining these spectra are described. When the principal contribution to the equipment response is due to flexibility of the supporting substructures, an analytical approach to the problem for obtaining reduced stiffness and associated mass matrices of supporting substructures with finite element representation for use in the dynamic analysis of equipment and supporting structures is presented. When supporting structures and equipment, that have inherently different damping properties, are included as integral parts of the dynamic models, the approximate evaluation of the modal damping based on the weighted damping according to the modal energy stored in each component is outlined. Use of time history and response spectrum analyses is presented. The effects of relative displacements due to different motion of the support points of substructures in each significant mode of the supporting structures as well as procedures of combining modal responses are detailed. (auth)

5288 REACTOR PRESSURE VESSEL INTEGRITY. Heavy Section Steel Technology Vessel Tests. Smith, D. Nucl. Eng. Int.; 19: No. 220, 751-761(Sep 1974).

A survey of work on the integrity of reactor pressure vessels is presented which consists of a brief introductory discussion in which it is maintained that confidence in nuclear vessels for light water reactors is strengthened by recent work in three fields: a report by the Advisory Committee on Reactor Safeguards on the probability of pressure vessel failures; ORNL work on the experimental testing of pressure vessels; and developments reported at the international conference on the in-service inspection of reactor pressure vessels in London, 1973. The Oak Ridge work is then discussed in some detail. This is part of the Heavy Section Steel Technology program. In a study of the tolerance of reactor pressure vessels to flaws, the testing of 6 in. cylindrical vessels of A508, class 2 forging steel and A533, grade B, class 1 plate steel is reported. Finally, a review is presented of developments in in-service examination of reactor vessels. This includes work presented at the London conference and also other projects on acoustic emission monitoring and acoustic holography. (UK)

5289 SEPARATION OF EMERGENCY SAFETY FEATURES SYSTEMS. Nucl. Eng. Int.; 19: No. 220, 765-766(Sep 1974).

Construction of light water reactors in the U. S. is undergoing further review in order to verify separation of safety systems in the as-built plant condition. The scope of the new U. S. AEC criteria defines requirements for the physical separation and identification of safety related electrical instrumentation and mechanical systems and equipment so that no single credible event is capable of disabling two or more redundant systems or equipment in the event of a design basis accident. Some significant definitions are given of the features involved. The way in which criteria are being implemented for typical units are described and certain general rules which apply in meeting the separation criteria are explained. (UK)

5290 MAKING THE CASE FOR NUCLEAR POWER. Rippon, S. Nucl. Eng. Int.; 19: No. 220, 741-743(Sep 1974).

In arguing the case for nuclear power the question of whether abundant cheap energy is needed is discussed. It is concluded that there is no quick way of limiting the growth trend. Over the next ten years all main sources of primary energy are likely to be stretched to their limit, and it is important that the amount of wasted energy should be reduced and that waste heat be diverted for domestic and industrial use. There are sound economic reasons for investment in nuclear power, one being the eventual stabilizing effect on world oil prices. It is important that the nuclear industry should be able to present its case to the public. The responsible attitude of the industry to safety is stressed and the extent to which it applies the concept of multiple levels of protection is compared with the risks associated with enterprises in other fields. Finally, it is considered that more could be done to satisfactorily answer the charges made by those critics who are opposed to nuclear energy. (UK)

5291 SCALING CONSIDERATIONS OF EXPERIMENTAL POST-LOCA STEAM RELIEF. Brodrick, J. R.; Lowe, P. A.; Burchill, W. E. (Combustion Engineering, Inc., Windsor, CT). Contract AT(11-1)-2244. Nucl. Technol.; 24: No. 2, 137-148 (Nov 1974).

Experiments have been conducted to determine the nature of the hydraulic interaction between emergency core coolant (ECC) water injected into a cold leg of a pressurized water reactor (PWR) and steam passing through that cold leg during core reflood following a loss-of-coolant accident. Measurements of flow rates, fluid temperatures, and static and differential pressures were made in $\frac{1}{5}$ and $\frac{1}{3}$ linear scale models of the PWR piping from the steam generator of an intact loop to the break including the pump inlet piping (loop seal), pump, cold leg, reactor vessel annulus, and broken cold leg. The principal conclusion is that the injection section performs as a jet condenser with 45-, 60-, and 75-deg injection; and condensation, but no jet pumping, occurs with 90-deg injection. The results also indicate that total condensation occurred in the cold leg in all tests where the water injection rate was sufficient to condense the steam assuming thermodynamic equilibrium. The data suggest that the differential pressure measured in the cold leg across the ECC injection nozzle, the water axial momentum flux, and the steam momentum flux can be combined into appropriate nondimensional groups in order to extrapolate the results to full scale. In addition, the data suggest that the influence of jet condenser stability upon the injection section pressure differential may decrease with increasing system size. (auth)

5292 SYSTEM FOR CONTROLLING RADIOACTIVE SUBSTANCES RELEASED WITH WASTE WATER FROM NUCLEAR POWER STATIONS. Wolter, R. (Bundesgesundheitsamtes, Berlin-Dahlem, Ger.). pp 360-379 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Paris; Organisation for Economic Co-operation and Development (1974).

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974). See CONF-740556-.

Waste water of nuclear power stations is analyzed for γ-emitting radionuclides and Sr-90, Sr-89 and H-3 emitting only β-rays. The use of a computer simplifies the analytical methods and prevents faults. The data resulting from these investigations are processed so that they can be easily evaluated in respect to many different aspects. The waste water released from seven nuclear power plants is analyzed according to this system since 1970. The system is explained and some results are given. The composition of the mixture of radionuclides in waste water from these power plants varies so much that the radioactive substances released can be balanced only if every sample is analyzed for the different radionuclides. A balance of emission of the different radionuclides has to be carried out as it is a necessary presupposition for each estimation of potential radiation exposures of men. (auth)

5293 SYSTEM SAFETY DESIGN OF MULTIPURPOSE HIGH TEMPERATURE EXPERIMENTAL REACTOR. Yamada, M.; Shimazu, A.; Morimoto, T. (Fuji Electric Co. Ltd., Tokyo). Fuji Jiho; 47: No. 4, 351-360(Apr 1974). (In Japanese).

The safety considerations of the second preliminary design of a multipurpose high temperature experimental reactor have been studied in order to obtain fundamental information. The design output of the helium-cooled and graphite moderated reactor is 50 MW(t). The coolant gas with 1,000°C temperature at reactor outlet is used for the generation of reducing gas in iron smelting and for driving a gas turbine. The aspects of the safety system design study are as follows: assumption of possible accidents and their analyses; plant dynamic analysis of dual purpose components; evaluation of radioactivity released both in normal operation and in major plant accidents; establishment of design safety standards; and engineering safety equipment for plants. (JA)

5294 POLYMERIC PROTECTIVE COATINGS USED AT NUCLEAR POWER PLANTS. Dzhurinskii, M. B.; Gol'din, V. I.; Vernik, V. S. Energ. Stroit. Rubezhom; No. 1, 8-10(1973). (In Russian).

In nuclear power plants special attention is given to the quality and condition of the surface of rooms and instruments. Additional requirements are imposed on construction materials: guarantee of the radiation stability, capacity for shielding effects, and the possibility of decontamination of surfaces. In foreign practice significant experience has been accumulated on the successful use of polymer coatings for special shields for construction materials. Polymer materials of two types were used: lacquer-paint materials and sheet and film materials. Examples are given of the use of different materials in the USA, the Netherlands, Belgium, and the Federal Republic of Germany. These include polyvinyl chloride coatings, perchlorvinyl materials, protective coatings based on epoxide resins, and polyether, vinyl, and epoxide lacquers. The technology and use of "kolturit" paints for coating construction materials of nuclear power plants are examined. These paints possess good corrosion stability, water stability, heat stability, and capacity for de-activation. Easily deactivated plate and film materials particularly recommend themselves. The coating of floors with soft polyvinyl chloride is widely used. In Belgium nuclear power plant floors are coated with welded plates of plastic materials which form an easily deactivated and easily removable flat surface. Polyethylene films and pipes and pipes from solid and soft polyvinyl chloride are widely used. (tr-auth)

5295 COMPELLING PRIORITY: INTERNATIONAL STANDARDS FOR NUCLEAR SAFETY. Doub, W. O. Pub. Util. Fortn.; 94: No. 7, 66-68(26 Sep 1974).

The need for a strong effort toward international cooperation in the writing of nuclear safety standards and safeguards is emphasized, and the unique opportunities for beginning this task presented by the World Energy Conference are discussed. (DG)

5296 NOTIFICATION OF RECOMMENDATIONS OF THE REACTOR SAFETY COMMISSION (RSK). May 28 1974. IRS Kurz-Inform., Reihe C; No. 9, 1-11(1974). (In German).

Results are presented of consultations in Sessions 89 to 92 of the RSK concerning: fracture safety of PV's; BASF reactor; environmental impact of nuclear energy; SNR 300; site of the Grafenrheinfeld nuclear power plant (PWR) near Schweinfurt; safety concept of the Muelheim-Kaerlich nuclear power plant (PWR); concept of the nuclear power plant of the Wenese Co. (PWR); RSK Guidelines and Safety Criteria; Type 72 of the KWU; Pu storage of the Alkem Co. (GE)

Reactor Theory and Calculation

Refer also to abstract 5217.

5297 (BAW-TP-332) STRIP: RESONANCE ABSORPTION PROGRAM TREATING OVERLAP AND INTERFERENCE. Helholtz, J.; Roy, D. H. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Atomic Energy Div.). Sep 1967. 78p.

STRIP is a FORTRAN-IV program for calculating resonance integrals in the resolved range, taking explicit account of overlap and interference between the resonances. A fast method for the numerical solution of the slowing-down equations has been developed, and a computer program has been written which permits resonance integral and effective resonance cross-section studies involving a large number of isotopes and resolved resonances. The geometric options include a homogeneous or a two-region calculation; in the latter case the flux in the outer region may be calculated or assumed asymptotic. Several fuel lump shapes are allowed. The solution of the slowing-down equations assumes isotropic scattering in the CM system and a flat flux approximation in each region. Both of these approximations are valid for the majority of the practical problems encountered in reactor design. The cross sections are calculated from s-wave resonance parameters, and tabulated corrections may be applied. Resonance integrals and effective resonance cross sections may be computed for an arbitrary input group structure. 19 references. (auth)

5298 (CNAEM-R-113) TIME EIGENVALUES OF THE NEUTRON-TRANSPORT EQUATION FOR FAST, SUBCRITICAL ASSEMBLIES. Adalioglu, U.; Duderstadt, J. J. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). 1973. 20p. Dep. NTIS (US Sales Only) $4.00.

The time decay constants characterizing the time behavior of a neutron pulse in a subcritical fast assembly are investigated by analyzing the time-eigenvalue spectrum of the transport operator for fast neutrons. To simplify this analysis, isotropic scattering was assumed, and a simple model of inelastic scattering was employed. By applying the techniques of functional analysis familiar from the study of the time-eigenvalue problem for thermal neutrons, it has been possible to classify the spectrum of the transport operator into the usual band spectrum for $\mathrm{Re}\{s\} \leq -\lambda^*$, where λ^* is the minimum collision frequency, and a point spectrum in the region $\mathrm{Re}\{s\} > -\lambda^*$. It was demonstrated that this point spectrum was void for either sufficiently small assembly sizes or sufficiently small concentrations of fissile material. (auth)

5299 (CONF-740903-11) VARIATIONAL SENSITIVITY ANALYSIS: THEORY AND APPLICATION. Henryson, H. II; Hummel, H. H.; Hwang, R. N.; Stacey, W. M. Jr.; Toppel, B. J. (Argonne National Lab., Ill. (USA)). Sep 1974. 12p. Dep. NTIS $4.00.

From meeting on advanced reactors; physics, design and economics; Atlanta, Georgia, USA (8 Sep 1974).

The theory underlying the variational sensitivity formalism is reviewed. Some general characteristics of uncertainties in fast reactor parameters as a function of nuclear data uncertainties are discussed. Numerical studies based on the variational sensitivity theory and the statistical theory are reviewed. (auth)

5300 (JAERI-M-5664) OPTIMAL REACTOR SHUTDOWN PROGRAMS INVOLVING SAMARIUM POISONING. Kitamura, M.; Shinohara, Y. (Japan Atomic Energy Research Inst., Tokyo). Apr 1974. 34p. (In Japanese). NTIS (US Sales Only).

Optimal flux programs which minimize reactor poisoning due to samarium buildup after shutdown of a high flux thermal reactor are described. The problem, defined as the trajectory optimization for the system described by a set of ordinary differential equations, is transformed to the optimization problem in a multi-dimensional Euclidian space by approximating the continuous-time system by a discrete-time system. By the statistical search technique, called random reward method, numerical solutions are obtained within the acceptable computational efforts. The effectiveness of optimization is evaluated, and some useful information for more general shutdown optimization problems involving other reactivity effects (temperature effect, xenon buildup, etc.) is obtained. The optimization is also done by the Powell's algorithm, a nonlinear optimization technique. The performance of the two optimization techniques is compared. (auth)

5301 (JAERI-M-5712) STUDY OF THE OPTIMAL XENON–SAMARIUM CONTROL PROBLEM BY A STATISTICAL SEARCH METHOD. Kitamura, M.; Shinohara, Y. (Japan Atomic Energy Research Inst., Tokyo). May 1974. 36p. (In Japanese). NTIS (US Sales Only).

The optimal control problem in shutdown of a high flux thermal reactor is studied by means of the statistical search method. The reactor dynamics model involves the reactivity effect due to xenon and samarium poisoning and temperature reactivity effect. The numerical results and the convergence property of the search method are described. (auth)

5302 (KFKI–74–45) SELF-SHIELDING OF UNRESOLVED RESONANCES: THE COMPUTER CODE ERICA. Gado, J. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 24p. Dep. NTIS (US Sales Only) $4.25.

Self-shielding effects of unresolved resonances were neglected in the reactor physics model of the Reactor Physics Department of CRIP. The ERICA code written for the ICL-1905 computer was written to take into account these effects. The description of the program and some calculational results are reported here. (auth)

5303 (RT/FI-(74)37) SUMMARY OF REACTOR PHYSICS ACTIVITIES IN ITALY IN THE PERIOD JULY 1973–June 1974. Farinelli, U. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Sep 1974. 45p. Dep. NTIS (US Sales Only) $5.25.

Information on reactor physics programs in Italy is presented concerning theoretical and experimental studies, light water reactor physics, heavy water reactor physics, fast reactor physics, high temperature graphite reactor physics, shielding, nuclear data evaluation and processing, and fusion reactors. (DCC)

5304 CALCULATION OF THE GAMMA RADIATION SPECTRUM OF A WATER-MODERATED WATER-COOLED REACTOR. Brickman, B. A.; Bondarev, V. D.; Zakharov, L. N. At. Energ. (USSR); 37: No. 3, 208-211(Sep 1974). (In Russian).

The gamma radiation spectrum of a water-moderated water-cooled research reactor was calculated by the Monte Carlo method using the GAMMA-2 program. The core and water reflector of the reactor were represented in the form of an infinite multi-layered cylinder. Prompt gamma radiation of ^{235}U fission, gamma radiation of fission fragments, radiation capture in ^{235}U, H_2, Al and Zn, Zr, Sn and Pb in succession were considered as sources of radiation. The differential spectrum of gamma radiation was obtained in the range 0.01–10 MeV for three variants of core loading and four experimental reactor channels of various loading. The energy release in various materials irradiated in the channels was calculated. A comparison of calculated and experimentally obtained energy release shows close agreement near the core and significant divergence in the reflector. The mass coefficients of gamma ray absorption averaged over the spectrum for a broad set of elements for two types of spectra have been calculated. In passing from the core to the reflector the spectrum softens considerably, which leads to a significant change in the mass coefficients of absorption for materials with large Z. (auth)

5305 COMPARISON OF DISADVANTAGE FACTOR AMONG SQUARE, HEXAGONAL, AND CYLINDRICAL CELLS. Azekura, K. (Osaka Univ., Suita, Japan); Sekiya, T.; Takeda, T. J. Nucl. Sci. Technol. (Tokyo); 11: No. 6, 269-271(Jun 1974).

Precise calculations were made of the neutron flux distribution in square and hexagonal cells by using an improved first-flight collision probability method. Cells containing both fuel and moderator are treated. Moderator-to-fuel flux ratios are tabulated for a number of different cases. Results of a previous calculation [Takeda et al., J. Nucl. Sci. Technol., 9: No. 1, 53 (1972)] are considered to be in error. (1 figure, 2 tables) (RWR)

Reactor Components and Accessories

Refer also to abstracts 3440 and 5374.

5306 (FRNC-CONF-109) TV AUTOMATION IN NUCLEAR POWER STATIONS. Pages, P. (Thomson-CSF, 75 - Paris (France)). 1973. 12p. (In French). (CONF-730983-15). Dep. NTIS (US Sales Only) $4.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

In the operation of atomic power plants a great number of data are involved. In some fields, however, sight checking remains necessary, especially as regards security. In this respect closed circuit TV provides big potentialities, and may be used wherever direct observation is impossible (channels, reactor vessels), or dangerous (radiation). It permits: broadcasting the image of a phenomenon; centralizing several data in one single point; and storing an event. Two cameras especially designed for conducting visual surveys in active media will solve these problems—a cylindrical TV–camera for observation purposes inside the nuclear reactor, and a TV-camera with remote control arrangements for visual monitoring within a nuclear environment. An allweather camera helps to maintain security all around the plant. (FR)

5307 (FRNC-CONF-113) ALTERNATORS FOR HIGH POWERED NUCLEAR REACTORS. Therby, M. (Compagnie Electro-Mecanique (CEM), 75 - Paris (France)). [nd]. 20p. (In French). (CONF-730983-18). Dep. NTIS (US Sales Only) $4.00.

From congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

The increase in unit alternator capacity made possible and desirable by the rapid development of nuclear reactors raises considerable problems for manufacturers and operators of these machines. Various problems, concerning size, mechanical and electromagnetic constraints are described. A brief description of a 4-pole machine with a mixed cooling system and a 2-pole unit with water-cooled motor is included. (auth)

5308 (FRNC-CONF-117) LIQUID SODIUM ELECTROMAGNETIC PUMPS FOR NUCLEAR REACTORS. Chaminade, F.; Le Frere, J. P. (Groupement pour les Activities Atomiques et Avancees (GAAA), 92 - Le plessis-Robinson (France)). 1973. 11p. (In French). (CONF-730983-30). Dep. NTIS (US Sales Only) $4.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

Sodium-cooled nuclear reactors and the test installations which their development has instigated all use electromagnetic pumps. The areas of operation of the main types of electromagnetic pumps are described and certain specific installations which show how these machines can be adapted to be requirements of sodium reactor design engineers are reported. (FR)

5309 (RD/B/N-3025) SILICON–TARGET VIDICON TUBES ASSESSED FOR REACTOR INSPECTION UNDER SHUTDOWN CONDITIONS. Jones, A.; Wilkins, K. (Central Electricity Generating

Board, Berkeley (UK). Berkeley Nuclear Labs.). Apr 1974. 11p. Dep. NTIS (US Sales Only) $4.00.

Silicon target vidicon tubes are compared with conventional tubes for reactor inspection under shutdown conditions on the basis of laboratory comparison. It is concluded that although silicon target tubes operate at lower levels of illumination and recover rapidly from highlight overloads, they also suffer from slightly inferior resolution, less convenient automatic gain control, and a reduction of picture quality in representative γ-radiation fields. In addition, a conventional tube can be housed in a much smaller diameter head, an advantage which may be an overriding consideration in reactor inspection. Details are given of a simple electron circuit for testing television systems when used with a general purpose oscilloscope. (auth)

5310 (RDT-C-6-2T) DIFFERENTIAL PRESSURE TRANSMITTER, PNEUMATIC OR ELECTRIC OUTPUT SIGNAL. (USAEC Division of Reactor Research and Development, Washington, D. C.). Apr 1974. 10p. RSO.

The requirements are presented for force balance differential pressure transmitters, which produce either an electric or a pneumatic signal output proportional to the difference in pressure across a diaphragm or capsule. The transmitter is intended to be used for the measurement of differential pressure, flow, or level in nonsodium fluid systems and gas systems. These units are not meant for use in the primary coolant system of nuclear reactors. (auth)

5311 (RDT-F-6-5T(08-74)) WELDING AND BRAZING QUALIFICATIONS (SUPPLEMENT TO ASME BOILER AND PRESSURE VESSEL CODE, SECTION IX). (USAEC Division of Reactor Research and Development, Washington, D. C.). Aug 1974. 55p. RSO.

Supplementary information on welding and brazing performance and procedure requirements is presented. Included are requirements for tube-to-tubesheet welds, seal welds, hard surfacing, and testing methods. (DG)

5312 (RDT-F-9-4T(09-74)) REQUIREMENTS FOR CONSTRUCTION OF NUCLEAR SYSTEM COMPONENTS AT ELEVATED TEMPERATURES (SUPPLEMENT TO ASME CODE CASES 1592, 1593, 1594, 1595, AND 1596). (USAEC Division of Reactor Research and Development, Washington, D. C.). Sep 1974. 17p. RSO.

Rules for the construction of Class 1 nuclear components, parts, and appurtenances for use at elevated temperatures are presented. This standard is a complete set of requirements only when used in conjunction with the ASME Code Cases 1592, 1593, 1594, 1595, and 1596, Section III of the ASME Boiler and Pressure Vessel Code (including Addenda), and RDT E 15-2. (auth)

5313 APPLICATION OF THE UNEVEN STEAM CONDENSER TUBES IN STEAM TURBINES AT CONVENTIONAL AND NUCLEAR POWER PLANTS. Genis, S. N.; Kulik, P. V.; Savvina, M. R. Energ. Stroit. Rubezhom; No. 4, 23-24(1972). (In Russian).

Turbines in nuclear power plants operate with saturated steam, and the condensers are 1.6 to 2 times greater than those in thermal power plants. In the USA the use in the condenser of tubes having fins on the external surface and flanges on the internal surface has been proposed. Tubes with spiral flanges on the internal and external walls are also manufactured. The principal advantage of spiral tubes is in the increase of the coefficient of heat transfer from the steam to the cooling water. The spiral tubes have smooth ends. The technology of their installation is not different from the usual installation and does not cause additional labor. (tr-auth)

5314 CLASSIFICATION OF COMPONENTS AND CONDITIONS FOR THE DESIGN OF NUCLEAR REACTORS. Cesari, F. Ing. Nucl.; 15: No. 1, 27-39(1974). (In Italian).

The classification of components developed by the USAS, ASME, IEEE, ORNL, and PEC is outlined. The design characteristics imposed by operating conditions are discussed. (JSR)

5315 DESIGNING NUCLEAR CONTROL VALVES. Freeman, M. Power (N. Y.); 118: No. 10, 39-45(Oct 1974).

Nuclear control valves are briefly discussed from the standpoints of applications, materials, specifications, seals, and quality assurance. (DG)

5316 SPRAG-TYPE CLUTCHES PROTECT NUCLEAR PUMPS AND DRIVE MOTORS AGAINST REVERSE ROTATION. Zlotek, T. F.; Lenef, D. M.; Florczak, M. S. Power (N. Y.); 118: No. 10, 48-49(Oct 1974).

A one-way clutch design is described which can take the place of check valves and electrical safeguards in preventing damage from backward motion of motor-driven pumps. (DG)

5317 THREE-DIMENSIONAL RUPTURE ANALYSIS OF A PRESTRESSED CONCRETE PRESSURE VESSEL INCLUDING CREEP EFFECTS. Saugy, B.; Zimmermann, Th.; Hussain, M. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Nucl. Eng. Des.; 28: No. 1, 97-120(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1974).

The results obtained from a nonlinear analysis up to rupture of a PCRV taking into account creep effects are briefly described. This analysis aims mainly at evaluating the influence of the redistribution of stresses due to the rheological behavior of concrete on the rupture pressure of a PCRV. First, the method of nonlinear analysis for creep and rupture is described briefly. The mathematical model, of a general application, is based on the finite element method, utilizing the isoparametric elements. Nonlinearities are introduced by the use of iterative techniques. It allows prediction, within satisfactory limits, of the behavior of massive prestressed concrete structures loaded up to destruction. The use of classical parameters for definition of the physical characteristics of materials for formulating the constitutive laws makes the model particularly interesting for practical applications. The analysis of the PCRV for a gas-cooled fast reactor developed by the Swiss Federal Institute for Reactor Research is also presented. This PCRV has large cavities in its walls to house direct cycle gas turbines and other mechanical equipment. First, the creep analysis is carried out taking account of the envisaged construction schedule and the loading during the testing period and finally during the normal exploitation of the PCRV. Proceeding from the state of stress obtained as such the rupture analysis is carried out for a sudden increase of internal pressure and temperature gradient due to a hypothetical accident. (auth)

5318 RECENT DEVELOPMENTS IN THE FINITE ELEMENT ANALYSIS OF PRESTRESSED CONCRETE REACTOR VESSELS. Argyris, J. H.; Faust, G.; Szimmat, J.; Warnke, E. P.; William, K. J. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen). Nucl. Eng. Des.; 28: No. 1, 42-75(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1974).

Recent developments in the nonlinear deformation and ultimate load analysis of prestressed concrete reactor vessels using finite elements are described. First a number of finite element models are called into attention for the idealization of composite structures such as reinforced and prestressed concrete components. Then different inelastic constitutive models are proposed for the behavior of concrete in the pre- and post-failure regime. Subsequently various numerical techniques are examined for the solution of nonlinear problems, especially with regard to their distortion of the constitutive model. In conclusion these modelling techniques are applied to the analysis of four typical examples, the nonlinear deformation analysis of a concrete specimen subjected to biaxial compression, the crack analysis of a thick-walled concrete cylinder, the overload analysis of the THTR 1:5 scale model, and the ultimate load analysis of a concrete top closure model. (auth)

5319 STANDARDS AND SPECIFICATIONS FOR SELECTING OPTIMUM NUCLEAR REACTOR PRESSURE BOUNDARY METALS - A REVIEW OF US APPROACHES AND NEEDS. Steele, L. E. (Naval Research Lab., Washington, D. C. (USA)). Nucl. Eng. Des.; 27: No. 1, 121-137(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Standards and specifications which optimize the quality of structural components including pressure boundary materials fill an important place in assuring reactor structural reliability. The ways in which research may contribute to improve codes, standards, and specifications for nuclear reactor pressure boundary metals, considering radiation and other service environmental effects are reviewed. Examples are cited from studies related to both thermal and fast reactor materials. The organizations and their current emphasis for standards development in the US also are reviewed briefly with specific reference to pressure boundary materials for commercial nuclear power plants. (auth)

5320 GENERALIZED PROCEDURES FOR THE USE OF PLANE STRAIN AND ELASTIC-PLASTIC FRACTURE MECHANICS OPTIONS IN THE MODERNIZATION OF NUCLEAR STANDARDS. Loss, F. J.; Hawthorne, J. R.; Pellini, W. S. (Naval Research Lab., Washington, D. C. (USA)). Nucl. Eng. Des.; 27: No. 1, 77-93(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

In the design of nuclear power plants and the selection of required structural materials, the assurance of reliability in operation is an essential consideration. The need for analytical criteria for defining the adequacy of fracture toughness is particularly acute for pressure vessel materials. The 1972 revision to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Section III) has adopted linear elastic fracture mechanics (LEFM) methods as a means of assuring fracture-safe operation for nuclear vessels and components. It is noted that LEFM can be used to analyze only the behavior of metals subjected to plane strain constraint (i.e. brittle behavior), while many steels when used in structural applications will behave in a ductile fashion. Thus, in the modernization of nuclear codes, there is the additional need to include the full range of fracture mechanics options for system design, that is, elastic-plastic and fully plastic fracture mechanics as well as the linear elastic procedures. The choice of a particular toughness regime for application of the metal (e.g., plane strain or elastic-plastic) can then be made by the designer or regulatory body. It follows that this decision will have a major implication on the selection of nuclear structural materials. Recent developments in the means for defining the full range of plane strain, elastic-plastic, and plastic fracture mechanics options available to the designer are described. Comparisons are made between these options and the fracture toughness requirements of the ASME Nuclear Code (Section III). Existing dynamic plane strain, K_{Id}, data for structural metals are analyzed in concert with dynamic tear (DT) test trends. The limited temperature region of K_{Id} applicability for these materials is shown to presage the elastic-plastic regime through which sharply increasing stress is required for fracture propagation whereby a leak-before-fail condition is ultimately attained. This phenomenon highlights the need to extend the analytical capabilities for fracture assurance into the non-brittle regime. The DT test is an effective engineering tool which, like the crack opening displacement (COD) concept, can be used to define the elastic-plastic and plastic-constraint transitions. (auth)

5321 ASSESSMENT OF ACTUAL LOADING CONDITIONS OF STEAM GENERATORS AND HEAT EXCHANGERS ACCORDING TO PROBABILISTIC CRITERIA. Beckmann, G.; Fritz, K. (Wagner-Biro, A. G., Vienna (Austria)). Nucl. Eng. Des.; 27: No. 1, 57-67(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Classical design codes are based on nominal conditions, e.g. pressure, temperature, material strength and tube diameter for tubes under pressure; local loads, hot spots, deviations in strength and geometry, etc. are compensated by the use of safety factors. More recent methods—in particular those for the assessment of steam generators and heat exchangers for nuclear applications—call for designs to meet actual loading conditions. Thus, detailed investigations are required to determine realistic operational characteristics of the components to be assessed. However, a worst case treatment on the basis of the above criteria would yield an over-conservative design which in special cases might even be worse than the classical one, e.g. in the case of heated tubes due to increased thermal stresses. As a consequence, with all the data or the spectra of data available, the assessment has to be executed according to probabilistic criteria resulting in a design with an acceptably low and, above all, known failure rate adjusted to fit into the overall plant concept. In components to which the above criteria have been applied before— mainly pressure vessels— the design variables pressure and temperature are generally considered uncorrelated and the temperature is in most cases assumed to be constant. For heat exchangers and steam generators these simplifications are not acceptable on principle. On the contrary, even deviations in geometry (like tube tolerances) result in flow rate deviations with corresponding deviations in temperature and pressure. Thus a new procedure for assessment according to actual loading conditions, e.g. by the application of probabilistic criteria, is proposed. This procedure can be used for heat exchangers and steam generators. With this new method, components of nuclear power plants like steam generators and heat exchangers may be designed to meet the low failure probability required for satisfying the overall reliability concept of the plant. (auth)

5322 NUCLEAR FUEL CORE WITH BYPASS COOLANT CONTROL. (to General Electric Co.). Netherlands Patent A7,215,404. 14 Nov 1972. Priority Date 26 Nov 1971, USA. 20p. (In Dutch).

A coolant bypass flow control arrangement is provided which reduces the differential pressure across the flow channel walls. This and other objects are accomplished by bypass flow area restriction devices located at the top of the core between the flow channels to control the exit of bypass flow from the core. In accordance with a first arrangement the bypass flow area restriction devices are attached to the top end of the flow channel. This arrangement requires no changes in the core support structure and thus it readily can be applied to previously constructed reactors. In accordance with a second arrangement the bypass flow area restriction devices are attached to the upper core support grid. (NL)

5323 INDUSTRIAL TECHNIQUE. (to Babcock and Wilcox Co.). Netherlands Patent A7,215,657. 20 Nov 1972. Priority Date 21 Dec 1971, USA. 16p. (In Dutch).

A heat exchanger that transfers heat generated within a nuclear reactor to a secondary coolant has a support system that accommodates thermal expansion and contraction as well as seismic forces through an arrangement of trunnions and trunnion bearings. The trunnions that are secured to the outer edge of the top tube sheet are limited to movement in a longitudinal direction. The bottom tube sheet trunnions confine the heat exchanger to movement in only one transverse direction. Turning moments produced at the trunnions because of these motions are relieved through lubricated rotation blocks in the trunnion bearings. (NL)

5324 IMPROVEMENTS IN OR RELATING TO MONITORING SYSTEMS. Grant, J. (to United Kingdom Atomic Energy Authority). British Patent 1,352,126. 8 May 1974. 8p.

The monitoring system described has means for feeding quantities to be monitored to "manifolds" arranged so as to group the quantities into overlapping fractions, together with means for monitoring the grouped quantities, and means for analysing the values obtained to indicate any feeding of abnormal quantities to the system. The system may be applied to the monitoring of activity in samples of reactor coolant. Examples are given and advantages of the system are described. (UK)

5325 INDUSTRIAL TECHNIQUE. (to Babcock and Wilcox Co.). Netherlands Patent A7,212,921. 25 Sep 1972. Priority Date 27 Oct 1971, USA. 13p. (In Dutch).

Stresses that are caused by the application of relatively cold feedwater to a heat exchanger tube sheet are alleviated. The colder feedwater that characterizes a low load condition in a nuclear power plant is admitted to the heat exchanger riser chamber that is adjacent to the primary coolant outlet head tube sheet by way of an inlet bypass system. The bypass prevents the thermal shock that otherwise would have resulted from the exposure of the tube sheet on the one side to cold inlet feedwater and, on the other side, to a very hot primary coolant. As the feedwater temperature increases with the power plant load and approaches the primary coolant outlet temperature, the bypass system is turned off. The main feedwater inlet nozzle then discharges into the heat exchanger in an essentially direct fluid communication with the tube sheet. (NL)

5326 INSTALLATION FOR THE MEASUREMENT OF THE VELOCITY OF FLOW OF THE COOLANT IN THE COOLING SYSTEM OF A NUCLEAR REACTOR. Gopal, R.; Weiss, H. H. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). German Patent 2234376/A/. 8 Feb 1973. 17p. (In German).
5 figs.

A system of two locally displaced detectors is described which respond to the gamma radiation of the ^{16}N activity in the coolant and are arranged in the immediate neighbourhood of the cooling circuit. A device is provided to correlate the first or second detector received initial signals and to form a cross-correlation function depending on the delay between each other of the corresponding points of the initial signals. (GE)

5327 NUCLEAR REACTOR PLANT. Weems, S. J.; McCurdy, H. W. Jr. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). German Patent 2239952/S/. 26 Apr 1973. 17p. (In German).
7 figs.

Recombination equipment to bond hydrogen and oxygen to form water is described. The equipment is placed in the containment of a water-cooled nuclear reactor. (GE)

5328 NUCLEAR REACTOR. Frisch, E.; Andrews, H. N.; Haga, P. B. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). German Patent 2242534/A/. 22 Mar 1973. 31p. (In German).
14 figs.

A reactor pressure vessel is described which can be closed by a cover pressed down by screws. The screws are anchored on one side like a slide catch. (GE)

5329 NUCLEAR REACTOR FUEL ASSEMBLY. Letendre, R. P. Jr. (to Combustion Engineering, Inc., Windsor, Conn. (USA)). German Patent 2253017/A. 12 Jul 1973. 11p. (In German).
4 figs.

The assembly consists of several parallel arranged fuel elements, between which there is a coolant flow channel with several deflectors to deflect the fluid flow in the channels. The shape and position of these deflectors, which are fastened to the spacer grids perpendicular to the direction of flow, are described. (GE)

5330 METHOD AND DEVICE FOR THE DETERMINATION OF FAILURES IN THE FUEL SUPPLY OF A NUCLEAR REACTOR. Weiss, H. H.; Johnson, R. J. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). German Patent 2236252/A/. 22 Feb 1973. 25p. (In German).
5 figs.

The process serves to detect fission products which have penetrated into the coolant as a result of a failure in the fuel rod cladding. The radioactivity emitted at the time from the coolant, after the decrease in the radioactivity during a first and a second delay period, is measured and compared to one another. The operating procedure of the gamma or neutron detectors as well as the measures taken to exclude undesirable interferences are described. (GE)

5331 QUALITY ASSURANCE EXPERIENCES IN THE FABRICATION OF PRIMARY COOLANT CIRCUIT COMPONENTS FOR US NUCLEAR POWER PLANTS. Maidorn, C.; Grote, G. (Kloeckner-Werke A. G., Osnabrueck (F. R. Germany)). Tech. Ueberwach.; 15: No. 6, 216-219(Jun 1974). (In German).
5 refs.

The plants of manufacturers of components for North American nuclear power plants are thoroughly controlled by especially authorized groups of U.S. experts. A quality assurance scheme, laid down in a special program report, guarantees that both materials and manufacturing methods comply with the standard requirements set up in the States. Methods, testing measures, and product control have to be checked and controlled in order to be able to trace back the various steps in the manufacture of a particular workpiece. Particular positions and steps in the manufacturing process have to be defined in advance for control by the authorized experts. (GE)

5332 NUCLEAR STEAM GENERATOR. Jabsen, F. S.; Schluderberg, D. C.; Paulson, A. E. (to Babcock and Wilcox Co., New York (USA)). German Patent 2234573/A/. 25 Jan 1973. 27p. (In German).
7 figs.

A heat exchanger is described in which primary and secondary flow routes of the fluid are connected to each other in counter flow. A splitting into part flow routes is intended. The heat exchanger can also be accommodated inside a reactor pressure vessel. The improvements deal with the pipes inside the heat exchanger (header, feeder pipe, longitudinal pipes). (GE)

Reactor Fuels

Refer also to abstracts 3055, 3056, 3058, 3813, and 3906.

5333 (AED-CONF-74-066-008) THERMO- AND FLUID-DYNAMIC INVESTIGATIONS FOR REACTOR FUEL ELEMENT DESIGN. Hoffman, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorbauelemente). 1974. 12p. (In German). INIS.

From status report for the Projekt Schneller Brueter; Karlsruhe, F.R. Germany (26 Mar 1974).
8 figs.; 14 refs. With abstract.

Methods for the calculation of flow and temperature distributions in fuel, breeding and absorber elements of different geometries are discussed, as well as the experimental evaluation of data required for the calculations, such as pressure drop and heat transfer relations. (GE)

5334 (ANL-8104) NONLINEAR FINITE-ELEMENT FORMULATION FOR TRANSIENT ANALYSIS OF THREE-DIMENSIONAL THIN STRUCTURES. Marchertas, A. H.; Belytschko, T. B. (Argonne National Lab., Ill. (USA)). Jun 1974. Contract W-31-109-eng-38. 49p. Dep. NTIS $4.00.

A finite-element procedure for transient analysis of plates and shells in three-dimensional space, applicable to large displacements and nonlinear material properties is described. This procedure uses a convected coordinate formulation enabling the use of a simple strain-nodal displacement, as well as nodal force-stress relations. The plate/shell element can be subjected to linear in-plane displacements and cubic transverse displacements. The orientation of lumped masses is described by unit vectors, so that arbitrarily large rotations can be treated. The discretized equations of motion are integrated explicitly in time with a central difference formula. Membrane artificial viscosity is used to stabilize occasional oscillations. The computational efficiency of the procedure is quite good: One element-time step takes 2 msec on an IBM 360/195 computer. Comparison of results with experimental data of impulsively loaded beams, plates, and shells shows good agreement. The program was applied to a hexagonal fuel subassembly loaded internally. Results are presented, and it is shown that, for this loading, two-dimensional cross-sectional models may be adequate. (auth)

5335 (BNWL-1862) CRITICAL EXPERIMENTS: BENCHMARKS (Pu–U SYSTEMS). Bierman, S. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1974. Contract AT(45-1)-1830. vp. Dep. NTIS $4.00.

Fourteen benchmarks on Pu–U systems are presented. These benchmarks have been assembled from the currently available experimental data. The benchmarks are presented in a useful format for validation of criticality codes. (JWR)

5336 (EURFNR–1167) ANALYSIS OF FUEL ROD STRESS UNDER POWER CYCLING ON THE BASIS OF EXPERIMENTAL DATA FROM CAPSULE EXPERIMENTS NOS. 4a, 4b, 5b, AND MOL 8B. Gerken, A. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Feb 1974. Translation of KFK–1913. 52p. Dep. NTIS (US Sales Only) $5.45.

Work performed under United States–Euratom Fast Reactor Exchange Program.

An attempt is made to explain the mechanical interactions between fuel and cladding more fundamentally. In the fuel rod irradiation program in the thermal reactor FR2, many pins have reached high burnups without any failure, but with large diameter increase (1.0–2.5% $\Delta d/d$). The reasons apparently were given by power changes in the pins, during operation. A modeling analysis shows that only the non-steady state conditions create these large diameter increases. All the parameters in this field were analyzed with a computer code. A fuel design and irradiation conditions are described which may bring down the mechanical interactions to zero. (auth)

5337 (JAERI-M-5674) DENSITY DETERMINATION OF THE COATING LAYERS OF FUEL PARTICLES. Ikawa, K.; Iwamoto, K. (Japan Atomic Energy Research Inst., Tokyo). Apr 1974. 18p. (In Japanese). NTIS (US Sales Only).

To develop methods of quality control for coated fuel particles, a series of experiments were conducted to determine the densities of the coating layers and also to assess the accuracy of the determination techniques. For the high-density pyrolytic carbon layer, the liquid displacement and the sink-float techniques were compared. The conditions of sample preparation were studied for the silicon carbide layer. The data obtained were treated statistically to assess the respective accuracies. Experiments conducted on a zirconium carboloy layer are also described. (auth)

5338 (JAERI-M-5691) STEADY-STATE RELEASE OF GASEOUS FISSION PRODUCTS FROM A COATED FUEL PARTICLE DURING IRRADIATION. Kikuchi, A. (Japan Atomic Energy Research Inst., Tokyo). Apr 1974. 18p. (In Japanese). NTIS (US Sales Only).

Trial calculations were made to estimate the effects of permeability, decay constant, and uranium contamination on the fractional release (R/B, R as the release rate and B as the birth rate). The relation between R/B and the above parameters was clarified by parameteric studies. (auth)

5339 (JAERI-M-5728) COMMENTARY ON THE PROGRAM GAPCONTHERMAL-1. Harayama, Y.; Izumi, F.; Fujita, M.; Kuriyama, M.; Uchida, M. (Japan Atomic Energy Research Inst., Tokyo). Jun 1974. 102p. (In Japanese). NTIS (US Sales Only).

The GAPCON-THERMAL-1 program, a computer program for calculating the gap conductance in oxide pins, is converted for use with the computers FACOM 230-60 or CDC 6600. The results of reviewing material properties, relationships and models incorporated in the program are described. Calculated values of material properties are given in figures and are compared with those reported in the literature. (auth)

5340 SOME APPLICATIONS OF BEAM, COLUMN AND PLATE THEORY TO PROBLEMS OF REACTOR FUEL ELEMENT DEFORMATIONS. Anderson, R. G. (UKAEA Reactor Group, Springfields). Nucl. Eng. Des.; 27: No. 1, 46-56(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Most early discharges of nuclear reactor fuel elements have been associated with exposure of the fuel to the coolant. Such failures have dominated the design and developments of gas and water-cooled thermal reactor fuel. It is less well known that a number of fuel discharges and reactor output limitations have taken place in thermal reactors because of fuel element deformations which have occurred without loss of clad integrity. Recent developments in the physical understanding of fuel element deformations during life are reviewed. The important features of these deformations are established using approximations leading to simple theoretical analyses of fuel elements deforming in the presence of creep. This theoretical treatment is applied illustratively to the following problem areas: (1) the change of thermal bow as the bending moments induced by lateral restraints relax due to creep; (2) the restraint of fast reactor sub-assembly bowing; (3) the estimation of lateral deflections in lengthening fuel pins which are restrained axially; and (4) the causes of waving of the heat transfer surfaces of certain uranium-magnox fuel elements. It is concluded from these examples that many of the characteristics of fuel element deformations during life can be obtained from quite simple ideas and mathematical analyses. The methods thus provide a useful tool for design and research. (auth)

5341 NUCLEAR FUEL ELEMENT. (to General Electric Co.). Netherlands Patent A7,216,757. 8 Dec 1972. Priority Date 8 Dec 1971, USA. 15p. (In Dutch).

A nuclear fuel element for use in the core of a nuclear reactor is disclosed. The nuclear fuel element has disposed therein an alloy having the essential components of nickel, titanium and zirconium, and the alloy reacts with water, water vapor and reactive gases at reactor ambient temperatures. The alloy is disposed in the plenum of the fuel element in the form of strips and preferably the strips are positioned inside a helical member in the plenum. The position of the alloy strips permits gases and liquids entering the plenum to contact and react with the alloy strips. (NL)

5342 NUCLEAR FUEL ELEMENT. (to General Electric Co.). Netherlands Patent A7,216,756. 8 Dec 1972. Priority Date 8 Dec 1971, USA. 16p. (In Dutch).

A nuclear fuel element for use in the core of a nuclear reactor is disclosed. The nuclear fuel element has disposed therein an alloy having the essential components of nickel, titanium and zirconium, and the alloy reacts with water, water vapor and reactive gases at reactor ambient temperatures. The alloy is disposed in the plenum of the fuel element in the form of particles in a hollow gas permeable container having a multiplicity of openings of size smaller than the size of the particles. The openings permit gases and liquids entering the plenum to contact the particles of alloy. The container is preferably held in the spring in the plenum of the fuel element. (NL)

5343 NUCLEAR FUEL ASSEMBLY. (to General Electric Co.). Netherlands Patent A7,213,247. 29 Sep 1972. Priority Date 30 Sep 1971, USA. 23p. (In Dutch).

A fuel assembly for a nuclear reactor is described wherein a central cluster of the fuel rods of the assembly are fueled with initial plutonium and wherein a water tube is provided through the cluster to increase the neutron moderation in the region of the plutonium fuel, the water tube also providing axial support for the fuel rod spacers. (NL)

5344 ROD-SHAPED FUEL ELEMENT FOR THE GENERATION OF SUPERHEATED STEAM. Miss, R. W. (to Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (F. R. Germany)). German Patent 2155175/S/. 10 May 1973. 21p. (In German).

5 figs.

The solid fuel inside the fuel element has a porous, gas and liquid penetrable structure and the pores between the fuel particles are filled and flowed through by the coolant to be evaporated. The fissile material spherical particles are firmly bound to one another by sintering and exhibit a non-penetrable layer for fission products. (GE)

5345 NUCLEAR FUEL ELEMENT. Grossman, L. N.; Packard, D. R. (to General Electric Co., Schenectady, N. Y. (USA)). German Patent 2259570/S/. 14 Jun 1973. 19p. (In German).

2 figs.

An improvement of a fuel element in the form of a getter is described containing a ternary alloy of zirconium, nickel and titanium and which is arranged in a low-temperature region of a nuclear fuel element. The task of the alloys is to react with water, steam and reactable gases in the region from 200 to 650°C. The present alloys in the form of strips contain about 3-12 wt.% nickel, about 3-30 wt.% titanium and the remainder of zirconium. The patent deals with the composition and arrangement of the getter as well as the setting-up and manufacture of the fuel element. (GE)

5346 SPACER GRID FOR NUCLEAR FUEL ELEMENT SUBASSEMBLIES. Raven, L. F. (to British Nuclear Fuels Ltd., London). German Patent 2301436/A/. 26 Jul 1973. 19p. (In German).

13 figs.

The grid consists of several connected cylindrical claddings. The technical details of the shape of these claddings as well as of their support in the grid are described. Springs are used as the essential localization element. (GE)

5347 PROCESS FOR THE FABRICATION OF PLUTONIUM CONTAINING FUEL RODS. Stoll, W. (to Alpha Chemie und Metallurgie G.m.b.H. (ALKEM), Leopoldshafen (F. R. Germany)). German Patent 2137133/A/. 1 Feb 1973. 7p. (In German).

1 fig.

The described fuel rod contains plutonium only in the cylindrical boundary zone of a nuclear fuel filling consisting of an uranium compound and surrounded by a cladding tube. For the fabrication, firstly the cladding tube inner wall is coated with a layer of a plutonium containing matrix and then the uranium containing nuclear fuel filling is brought into the cladding tubes. Type, size and method of inserting the plutonium containing particles are dealt with. (GE)

5348 FUEL ELEMENT ARRANGEMENT AND ITS SURROUNDING NUCLEAR REACTOR. Triggiana, L. V.; Ashby, G. E.; Sanchez, M. G. (to Grace (W. R.) and Co., New York (USA)). German Patent 2229715/S/. 22 Feb 1973. 43p. (In German).

6 figs.; 3 tabs.

The described arrangement consists of a series of level, longitudinally extended elements whose surfaces essentially lie in parallel planes, where each element has nuclear fuel and its inclusive coating plates. Between the coating plates, one or several plates are arranged, having cells of a diameter of 10 to 3,000 microns in which the nuclear fuel is to be found. The fuel contains fissile material, breeder material or a mixture of these and is assigned to the generation of a breeder reaction. The fuel is spherically shaped. (GE)

5349 NUCLEAR REACTOR WITH A SUPPORTING GRID FOR FUEL ELEMENTS. Lichtenberger, H. V. (to Combustion Engineering, Inc., Windsor, Conn. (USA)). German Patent 2254249/A/. 5 Jul 1973. 23p. (In German).

13 figs.

A system of spacer elements is described which on the whole serves as a support and holder for several parallel longitudinally extended fuel elements. The fuel elements are also constructed so that their ends can be safely inserted in the supporting grid. (GE)

5350 NUCLEAR FUEL CONFIGURATION. Fritz, J. R.; Channon, F. R. (to General Electric Co., Schenectady, N. Y. (USA)). German Patent 2247685/S/. 5 Apr 1973. 25p. (In German).

12 figs.

The arrangement of a great number of long fuel elements is described which embraces two groups of fuel elements: a first group, containing fissionable plutonium, and a second group which contains initially enriched fissionable uranium free of plutonium. Within the first (inner) group, there is a tube for inlet and outlet of the moderator, having the same external diameter as the fuel elements and being connected to the spacers. Essentially the type of connection is described. (GE)

5351 NUCLEAR FUEL ELEMENT. Grossman, L. N.; Levin, H. A. (to General Electric Co., Schenectady, N. Y. (USA)). German Patent 2259569/S/. 14 Jun 1973. 19p. (In German).

3 figs.

An improvement of a fuel element in the form of a getter is described containing a ternary alloy of zirconium, nickel and titanium and which is arranged in a low-temperature region of a nuclear fuel element. The task of the alloys is to react with water, steam and reactable gases in the region from 200 to 650°C. The present alloys in the form of strips contain about 3 to 12 wt.% nickel, about 3 to 30 wt.% titanium and the remainder zirconium. The composition and arrangement of the getter as well as the setting-up and manufacture of the fuel element are described. (GE)

Reactor Control Systems

5352 (CEA-CONF-2646) OPERATING CONTROL SYSTEMS IN ADVANCED TYPES OF NUCLEAR POWER PLANTS. Jeannot, A.; Quittet, Y.; Bonnemort, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de Construction des Reacteurs; Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1973. 16p. (In French). (CONF-730983-22). Dep. NTIS (US Sales Only) $4.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

A general description of operating control of the PHENIX reactor, covering the level of automaticity and the methods of data perception is given. The control of the core, the supervision of cooling, and the detection of cladding rupture are described. A summary description is given of the evolution of the SUPER-PHENIX reactor from its PHENIX predecessor. As regards high temperature reactors, control rods, the regulation of the flow of coolant gas, the system of emergency stoppage, and the general systems for safety and output limitation are discussed with special attention being paid to particular aspects of some of these control systems. (FR)

5353 (FRNC-CONF-107) ELECTRONIC DATA PROCESSING IN NUCLEAR POWER PLANTS. Moinereau, P.; Semenoff, G. (Societe d'Etudes Techniques et d'Entreprises Generales-Transmissions-Automatique-Informatique (SODETEG-TAI), 92 - Boulogne (France)). 1973. 17p. (In French). (CONF-730983-26). Dep. NTIS (US Sales Only) $4.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

The systems for centralized data processing in French nuclear plants have a range of different features and structures. However, they can be classified in terms of the level of processing achieved, from simple data acquisition at one extreme to automatic process control at the other. The operating methods of these systems are constantly evolving, in the direction of easier implementation. Examples of their application are given covering the plants at BRENNILIS, SAINT-LAURENT, PHENIX, TIHANGE and FESSENHEIM. (FR)

5354 (FRNC-CONF-108) DETECTORS AND NEUTRON CONTROL SEQUENCES. Arnaud, R. (Etablissements Merlin et Gerin, 38 - Grenoble (France)). 1973. 11p. (In French). (CONF-730983-27). Dep. NTIS (US Sales Only) $4.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

Neutron control of a reactor generally involves three distinct measurements sequences covering all aspects of the dynamics of neutron flux. The main technical aspects of the detectors used, and the electronic measurement techniques covering the start-up, intermediate and power sequences are described. The problems and the technological solutions characterizing the instrumentation are discussed and certain advantages of French nucleonic measurement instrumentation are presented. (FR)

5355 (IRI-131-73-01) CALCULATION OF ACCEPTABLE TEST INTERVALS AND REPAIR TIMES FOR COMPONENTS OF COMPOUND SAFETY SYSTEMS. van Dam, H. (Interuniversitair Reactor Instituut, Delft (Netherlands)). Nov 1973. 11p. (In Dutch).

Some often-used principles for safety control systems are discussed as well as the principles of reliability analysis. Questions to be answered are: (1) what is the chance of failure of a multicomponent system when the chances of failure of the components are given; (2) how can safe test intervals for safety control systems be determined; (3) how does one compute acceptable repair times in case one or more components fail during the test? In order to answer these, the redundance principle is explained with several examples. The reliability analysis is executed with statistical methods. The results are summarized as recommendations for safe plant operation. (NL)

5356 (ZJE-149) REACTOR CONTROL USING IPFM-TYPE CONTROLLER. Drab, F.; Rosol, J. (Skoda, Plzen (Czechoslovakia)). 1974. 16p. Dep. NTIS (US Sales Only) $4.00.

Using the Integral Pulse Frequency Modulated (IPFM) control signal in a reactor control system provides the system with certain advantageous properties. An application of the IPFM-type controller in reactor control is discussed. The relation existing between the IPFM modulation and the sequential analysis of signals is illustrated. Results obtained by experimental and analytical means are compared. Computer techniques may be made use of in the analysis and synthesis of reactor control systems provided with motor actuated control rods. (auth)

5357 USE OF COMPUTERS IN THE OPERATION OF ELECTRONUCLEAR PLANTS. Gangemi, F. (ENEL, Rome). Ing. Nucl.; 15: No. 1, 13-26(1974). (In Italian).

Problems in the operation of nuclear power plants in which online digital computers are used are briefly indicated. The characteristics required of a computer used in a nuclear power plant and the operational principles and structure of digital computers are discussed. The supervisory function of a computer is outlined. The use of a computer in the determination of the core power distribution of a boiling water reactor is described in some detail. (JSR)

5358 LINEAR STEP-DRIVE MECHANISMS OF NUCLEAR REACTORS WITH DISCRETE CONTROL SYSTEMS. Emel'yanov, I. Ya.; Voskoboinikov, V. V.; Starostin, E. A. At. Energ. (USSR); 37: No. 3, 198-202(Sep 1974). (In Russian).

The development of highly reliable control-rod drive mechanisms with linear step motors is considered. The operation of a discrete drive mechanism with a control computer is described. Drive system properties have been studied using a mathematical model. An experimental model has been tested. (auth)

5359 LIFT PISTON ASSEMBLY. (to Combustion Engineering, Inc.). Netherlands Patent A7,217,570. 22 Dec 1972. Priority Date 23 Dec 1971, USA. 32p. (In Dutch).

A hydraulic actuator is described for a nuclear reactor control rod assembly which may be positioned entirely with a reactor pressure vessel. The actuator is characterized by a lift piston which cooperates with the fuel assembly upper end fitting, at the lower end of the piston guide cylinder, and with a lift buffer assembly, at the upper end of the cylinder, to provide for both lifting of the control rod and for holding the control rod at the two limits of motion. (NL)

Nuclear Power Plant Economics

Refer also to abstract 4047.

5360 (FRNC-CONF-103) ECONOMIC ASPECTS OF NUCLEAR ELECTRICITY. Robin, A. (Electricite de France, 75 - Paris). 1973. 18p. (In French). (CONF-730983-28). Dep. NTIS (US Sales Only) $4.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

In view of Europe's explosion in energy requirements, its growing dependence on energy and new requirements for living conditions, intensive use of nuclear energy, i.e. of electricity, will be in the common interest of the producers and distributors of electricity. Cost comparisons of conventional and nuclear electricity already favor the latter. The future can only confirm these results, and the share of nuclear installations in the investments already programmed show that the nuclear option has already been accepted. The amounts involved are so large as to enhance the importance of the functions and responsibilities of electric power producers. (FR)

5361 (WASH-1345) POWER PLANT CAPITAL COSTS: CURRENT TRENDS AND SENSITIVITY TO ECONOMIC PARAMETERS. (USAEC Division of Reactor Research and Development, Washington, D. C.). Oct 1974. 76p. Dep. NTIS $5.45. GPO $1.40.

A description is given of power plant capital cost studies that were carried out as part of the program analysis activities of the Division of Reactor Research and Development. The activities include investment cost studies prepared by an architect-engineering company, including cost trends, cost effects of environmental and safety requirements, and construction schedules. Computer codes to be used to prepare capital cost estimates under varying economic conditions are described, and application of these codes is demonstrated by sensitivity studies. (auth)

5362 EXPERIENCE IN THE DESIGN AND CONSTRUCTION OF INDUSTRIALLY OPERATING PLANTS. Saitcevsky, B. (Electricite de France, Lyon). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 102, 6-20(Jul 1973). (In French).

The dozen nuclear power plants constructed by French industry are reviewed. Developments which have occurred since the early installations (Marcoule and Chinon) up to Saint-Laurent 1, Saint-Laurent 2, and Bugey 1 are discussed together with the conditions under which they were constructed (planning delays, assignment of contracts, difficulties encountered). The principal characteristics of Vandellos are recalled. The construction of the EL4 prototype plant at Brennilis is recalled together with that of the Chooz Franco-Belgian plant. The principal applications of nuclear techniques in other industrial sectors are enumerated. (FR)

5363 ENERGY PROBLEMS IN JAPAN AND OFFSHORE NUCLEAR POWER PLANTS. Hayashi, T. (Science and Tech. Agency, Tokyo). Genshiryoku Kogyo; 20: No. 1, 39-48(Jan 1974). (In Japanese).

Potential energy sources in the world are tremendous if nuclear fusion is included. The problem to be solved is to secure the means of harnessing them in harmony with the advance of civilization and environmental conservation. The concept of an offshore nuclear power plant is described. The environmental pollution from electric power generation is related to geographical and population aspects. Though nuclear power generation is much less problematic in this respect, its siting in Japan is becoming increasingly difficult. Accordingly the offshore nuclear power plant emerges as highly advantageous; in the case of Japan, the installation will be of a floating type due to seismic considerations. World developments in this direction are briefly discussed. (JA)

5364 NUCLEAR POWER: FUTURE INSTALLATIONS AND MATERIAL REQUIREMENTS. Russell, S. H. (Atomic Energy of Canada Ltd., Chalk River, Ont.). CIM (Can. Mining Met.) Bull.; 67: No. 749, 71-74(Sep 1974).

The total installed capacity of Canada's nuclear generating stations, which was 2500 MW(e) at the end of 1973, is expected to increase to more than 100,000 MW(e) by the year 2000. Most of these stations will be located in Ontario and Quebec. The distribution of costs for the construction and operation of a typical nuclear generating station is discussed. The data are then combined with the forecast installation of new stations to arrive at an estimate of the distribution of the total expenditures to be made for nuclear power up to the year 2000. (auth)

5365 ITALIAN NUCLEAR ACTIVITY IN 1973. Battistini, G. Ing. Nucl.; 15: No. 1, 5-12(1974). (In Italian).

From 5th annual meeting of the nuclear engineers of the ANDIN; Rome, Italy. (23 Mar 1974).

Industrial, nuclear power production, and research activities in Italy during 1973 are briefly summarized. Problems related to safety and environmental protection are cited. Activities carried out in union with Euratom are indicated. (JSR)

5366 LOCAL PARTICIPATION IN NUCLEAR POWER PROJECTS. Phillipp, J.; Forrest, J. A. Nucl. Eng. Int.; 19: No. 220, 761-765(Sep 1974).

The problem of determining the optimum level of participation in a nuclear power project by nationals of the country where the project is implemented and the best method of achieving this is discussed in some detail. The many factors which are involved include financial and economic considerations, the significance of the social and political policies of the country, the method of evaluating local resources, determination of the extent to which local supplies of components and materials may be provided, the use of local labor, also management and operating personnel, and local participation in undertakings such as engineering design, documentation and safety and licensing aspects. (UK)

5367 NUCLEAR POWER SYSTEMS. Some Principles. Rotherham, L. (Univ. of Bath, Eng.). Contemp. Phys.; 15: No. 5, 465-478(Sep 1974).

Some of the characteristics of nuclear power systems are derived from the historical evolution of nuclear technology but others are determined by the physics of the nuclear reactor core. This is illustrated by the fact that the size of the reactor core is, in large measure, dependent on the choice of moderator. If no moderator is used, as in the Fast Breeder Reactor, the fuel enrichment is high and the core is small giving a very high heat release per unit volume and considerable problems in the maintenance of safety requirements. There is a balance to be struck between low capital needs for a small core and high capital needs to provide for safety. There is a graduation in this balance for different thermal reactor systems and there are also consequences in the fuel economy of the different systems which can be considered. The choice of the best nuclear reactor system for any particular location is, therefore, a complicated one in which these divergent needs must be reconciled. (auth)

5368 FORECASTING AS AN AID TO R AND D DECISION MAKING IN THE NUCLEAR POWER FIELD. Brookes, L. G. (United Kingdom Atomic Energy Authority, London). R and D Manage.; 4: No. 3, 127-134(Jun 1974).

Attempts by the Atomic Energy Authority to forecast electricity requirements at and beyond the end of the century are described as a background to their consideration of the relative merits of alternative future nuclear power systems and the distribution of research effort between them. The study was conducted between 1969 and 1971. The danger of the Middle East countries restricting oil supplies and raising prices was foreseen but in a less acute form and later than has actually occurred. The recent developments are likely to lead to pauses in economic growth followed by growth at lower rates than otherwise. Where forecasts are given in the form of ranges, the lower bounds of the range are likely to apply—at least in the short and medium term. (auth)

5369 FUTURE POSSIBILITIES OF NUCLEOELECTRIC ENERGY IN MEXICO. Lartigue, G. J. (Universidad Nacional Autonoma de Mexico, Mexico City). Energ. Nucl. (Madrid); 19: No. 88, 77-79(1974). (In Spanish).

The increase in energy consumption in Mexico is discussed, and the reserves of the energy producers and their capacity for energy production are compared. The most feasible possibilities for the production of the needed energy are considered. The various types of nuclear reactors which could be used to meet the energy requirements are discussed. On the basis of resources, needs, and reactor capabilities, a series of alternatives is developed. (tr-auth)

5370 PRESENT STATE AND FUTURE DEVELOPMENT IN THE ELECTRIC POWER INDUSTRY IN USA. Falaleev, P. P.; Storozhuk, K. S.; Sapir, I. A. Energ. Stroit. Rubezhom; No. 4, 3-7(1972). (In Russian).

The present status and possibilities for the development of nuclear power plants in the USA are discussed. The production of electric energy in the USA was 4 billion kWhr in 1965, 6 in 1966, 8 in 1967, 13 in 1968, 14 in 1969, and 21 in 1970. In 1970 the capacity of the nuclear power plants was 6.5 million kW (2% of the total), but their production of electric energy was 1.1% of the total. At the end of 1970 16 power reactors were in operation. Data on the types, power, and year of start-up are presented. In 1970 nine nuclear power plants with a total power of 10.0 million kW were ordered. In the beginning of 1971, 54 nuclear power plants with a total power of 44 million kW were under construction. It was planned that 9.7 million kW would be produced by nuclear power plants in 1971, 11 in 1972, and 17.1 in 1973. By 1980 the total capacity of nuclear power plants of the USA should reach 150 million kW and amount to 22% of the total capacity of electric power plants, and 500 million kW (about 40% of the total power) are projected for 1990. It is expected that the annual growth of nuclear power would be 20 to 23 million kW in 1980, 38 to 40 in 1990, and 70 to 75 in 2000. Of 300 areas selected for construction of new electric power plants, 165 were proposed for nuclear power plants. The investment of the federal government and private companies in the development of nuclear power plants in 1970 was 2271 million dollars (their total investment in the development of energy is more than 12 billion dollars). One of the factors impeding the development of nuclear energy is the growth of the cost of construction of nuclear power plants. At the present the cost is 220/kW (in 1966 it was 100 to 150/kW). The increase of the cost can be explained by the growth of the price of instrumentation and materials, by increased interest costs, higher labor costs, and increased construction time. (tr-auth)

5371 PRESENT STATE OF NUCLEAR POWER GENERATION AND ITS TRENDS. Hirano, M. (Ministry of International Trade and Industry, Tokyo). Haikan Gijutsu; 16: No. 1, 150-163(Jan 1974). (In Japanese).

The recent development of nuclear power generation is discussed. Nuclear power is expected to play an important role in future energy production, especially in view of the current energy crisis and environmental pollution. However, the problems involved in it are many, including safety, environmental impact, stabilized fuel supply, and waste disposal. The following are described: the long-term need for nuclear power generation, the trends of power reactors, problems of nuclear fuel, the safety of nuclear power generation and environmental problems, and the trends of waste treatment and disposal. (JA)

Reactor Fuel Cycle Economics

Refer also to abstract 4035.

5372 (CEA-CONF-2642) FRENCH FUEL-CYCLE INDUSTRY, SPECIAL REPORT. Devilliers, J. P. (CEA Direction des Productions, 92 - Chatillon (France)). 1973. 12p. (In French). (CONF-730983-14). Dep. NTIS (US Sales Only) $4.00.

From congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France (11 Sep 1973).

The world nuclear fuel cycle industry is characterized by a very high foreseeable growth rate, linked to the rate of power plant construction (a turnover of 40 billion francs is forecast for 1985); a ratio of investment to annual turnover in excess of two; advanced technology; and severe competition. The structure of this highly concentrated industry is changing rapidly. The powerful business groups interested in it are each seeking to integrate to cover all phases of the cycle. The four reports on this subject describe the present position of the French industry, its technical possibilities and the outlook for it. The results obtained in connection with exploration for and production of natural uranium, the construction of a gaseous diffusion separation plant, the work on fuel fabrication, and the construction of a number of reprocessing units show that it is possible to anticipate the development in France of a fuel cycle industry capable not merely of covering a higher share of national needs but also of exporting supplies to foreign markets. (FR)

5373 (GKSS-74/E/26) KOSTEN, A COMPUTER PROGRAM FOR THE DETERMINATION OF THE FUEL CYCLE COSTS OF NUCLEAR REACTORS. Jager, W.; Peltzer, M. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1974. 78p. (In German). Dep. NTIS (US Sales Only) $7.00.

The KOSTEN computer program is used for the determination of the fuel cycle costs of reactors. Since the income and expense arising in connection with fuel consumption care distributed over a long time span, the calculations are made by the cash value method. The program considers the discontinuous fuel consumption by treatment of each individual partial charge. A description of the method, the input data, a complete FORTRAN list of the program, and an example are given. (tr-auth)

5374 REACTOR MEETING, BERLIN, GERMANY, APRIL 2–5, 1974. Bonn; Deutsches Atomforum E. V. (1974). 770p. (In German and English). (CONF-740468-).

Information is presented concerning reactor design and experiments; fuel elements, fuel cycle, and isotope technology; design, construction, and operation of power reactors and their components; and reactor concepts and economic aspects. (DCC)

Reactor Licensing and Regulation

Refer also to abstract 3059.

5375 (DOCKET-50206-324) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Semiannual Operating Report No. 14, January–June 1974. (Southern California Edison Co., Rosemead (USA)). 14 Aug 1974. 35p. Dep. NTIS $4.75.

At the start of the period, the unit was shut down to repair the low pressure turbine blades and the safety injection piping. The unit returned to service 1/22/74. The unit was removed from service 4/27/74 to affect repairs to the reheaters, generator hydrogen blower and two leaking steam generator tubes. The unit returned to service 5/20/74. Gross thermal power generated (MWH) was 4,224,705,882 and the net electrical power generated was 1,362,702,000. The reactor was critical for 3337.93 hours with on-line generation of 3279.87. Information is presented on operations, power generation, shutdowns, maintenance, radioactive effluent releases, solid wastes, environmental monitoring, and operational personnel radiation exposures. (FS)

5376 (DOCKET-50254-480) QUAD-CITIES STATION, UNITS 1 AND 2. Semiannual Report, January–June 1974. (Commonwealth Edison Co., Chicago, Ill. (USA)). 22 Aug 1974. 147p. (DOCKET-50265-422). Dep. NTIS $10.50.

Information is presented concerning operation, power generation, shutdowns, maintenance, changes, tests, experiments, and occupational personnel radiation exposures. The radioactive waste and environmental monitoring programs, monitoring effluents, solid wastes, site meteorology, gamma radiation, airborne iodine 131, aquatic radioactivity, terrestrial deposition, vegetables, and ground water are described. (FS)

5377 (DOCKET-50259-480) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Semiannual Report, February 18, 1974–June 30, 1974. (Tennessee Valley Authority, Chattanooga (USA)). 3 Sep 1974. 37p. Dep. NTIS $5.00.

Information is presented concerning operations, power generation, shutdowns, maintenance, changes, tests, experiments, primary coolant chemistry, occupational personnel radiation exposure, effluent releases, solid radioactive wastes, nonradiological environmental in-plant monitoring, and environmental monitoring. (FS)

5378 (DOCKET-50266-223) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Semiannual Operation Report No. 8, January–June 1974. (Wisconsin Electric Power Co., Milwaukee (USA)). 26 Aug 1974. 108p. (DOCKET-50301-191). Dep. NTIS $8.50.

For this period, Unit 1 operated at an average capacity factor of 59.9% with a net efficiency of 30.42%. The plant and reactor availability were 65.23% and 72.48% respectively. Unit 2 operated at a capacity factor of 94.72% at an average efficiency of 31.01%. The plant and reactor availability was 100%. Plant operations are summarized. Reactor maintenace, instrumentation and control, chemistry, health physics, abnormal occurrences, design changes, and the environmental monitoring program are described. (FS)

5379 (DOCKET-STN-50522-1) SKAGIT NUCLEAR POWER PROJECT, UNITS 1 AND 2. License Application, PSAR, Application for Construction Permit and Operating License. (Puget Sound Power and Light Co., Bellevue, Wash. (USA)). 1974. 343p. (DOCKET-STN-50523-1). Dep. NTIS $20.25.

An application is presented for a power facility consisting of two BWR/6 type reactors, each with a core power of 3800 MW(t) and net electrical generation of 1288 MW(e). The plant is to be located in the Skagit River Valley 64 miles north of Seattle, 23 miles southwest of Bellingham, 3 miles west of Lymen, 6 miles west-southwest of Hamilton, and Sebro Woolley 6 miles to the east-southeast. Natural draft cooling towers are provided. (FS)

5380 (DOCKET-STN-50528-1) PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3. License Application. (Arizona Public Service Co., Phoenix (USA)). 1974. 409p. (DOCKET-STN-50529-1; DOCKET-STN-50530-1). Dep. NTIS $23.50.

An application is presented for a nuclear power facility to be located 36 miles west of Phoenix and two miles south of Wintersburg in Maricopa County, Arizona. There will be three "System 80" pressurized water reactors contained in steel-lined, prestressed-concrete, cylindrical structures with hemispherical domes. The thermal power will be 3817 MW(t) with an electrical output of 1307 MW(e) for each unit. Mechanical cooling towers will be provided. Commercial operation is scheduled for 1981, 1982, and 1984. (FS)

5381 (FIND-STN-50437) FIND: OFFSHORE POWER SYSTEMS. Floating Nuclear Plants: Plant Design Report. Horn, F. H. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Oct 1974. 79p. Dep. NTIS $5.45.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DCC)

5382 (FRNC-CONF-118) NUCLEAR ENERGY AND SITE CAPACITY POLICY. Senechaut, P. (Electricite de France, 75 - Paris. Direction de l'Equipement). 1973. 15p. (In French). (CONF-730983-31). Dep. NTIS (US Sales Only) $4.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France(11 Sep 1973).

By the turn of the century, some 155 GW of nuclear installations will be in operation. The sites now being equipped are designed for 5 GW capacities. This will gradually evolve to 10-20 GW per plant. The only French river capable of cooling such plants is the Rhone, and techniques for atmospheric cooling and coastal placement are now being developed. Transport of energy is another potentially important problem. Although nuclear plants are firmly believed to be clean and reliable, environmental considerations persists and efforts to minimize nuisance are being maintained. Nuclear power plants are large facilities whose location must be planned in the framework of the centrally-co-ordinated policy for balanced geographical development ("Plan d'Amenagement du Territoire"). (FR)

5383 (INIS-mf-1170) NUCLEAR REACTORS AND INSURANCE. Di Veroli, A. (Instituto Nacional de Reaseguros, Buenos Aires (Argentina)). 1972. 132p. (In Spanish). INIS.

The hazards of nuclear reactors are discussed from the standpoint of insurance coverage and legislation. The future of nuclear energy in Argentina is considered and examples are given of development, especially in relation to construction of the nuclear power plant at Atucha. In an appendix is presented Law 25/1964, of April 29, from Spain, on nuclear energy, Decree 2177/1967, of July 22, where regulations on coverage of nuclear hazards, civil responsibility policies with regard to nuclear hazards, and damage from nuclear installations are given. Italian policies are quoted on insurance against material damages by nuclear explosions and civil responsibility for development of nuclear plants, including Law 1860/1962, of December 31, on peaceful uses of atomic energy and the policy of "total hazard of installation" and of material damages by nuclear energy (plant in operation). INIS

5384 (ORNL-TM-4702) STUDY OF THE FISSION PRODUCT RELEASE FROM A BADLY DAMAGED WATER-COOLED REACTOR. Hsia, D. Y.; Chester, R. O. (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. Contract W-7405-eng-26. 124p. Dep. NTIS $9.25.

Thesis. Submitted by D. Y. Hsia to Univ. of Tennessee, Knoxville.

A realistic model for fission product release from a badly damaged power reactor has been developed in this study. The vaporization of fission products by decay heat, the effects of the metal-water reaction, the deposition of particulate inventory in reactor vessels, and the leakage through the multiple containments are all considered in this model. The calculation shows that the vaporization of fission products can lead to a 35 percent reduction of the decay heat retained within the core. This effect is greatest for low-vapor-pressure fission products. The metal-water reaction heat available to vaporize UO_2 is about 10 percent of the decay heat available. The reaction heat can produce a reducing atmosphere surrounding the fuel leading to an increase of Ba and Sr releases by a factor of 30 or more. The effect of containment on the fission product release depends on the deposition properties of the specific fission product. But even a badly damaged containment can lead to a reduction of the fission product release by more than two orders of magnitude. A recirculating filter-absorber inside the containment can lead to a reduction of the particulate fission product release by more than one order of magnitude. (auth)

5385 (RAI-74-6) REGULATORY ADJUDICATION ISSUANCES AND ISSUANCES OF THE BOARD OF CONTRACT APPEALS, JUNE 1974. (USAEC Technical Information Center, Oak Ridge, Tenn.). Jul 1974. 393p. TIC $2.80.

Issuances received from the U. S. Atomic Energy Commission, the Atomic Safety and Licensing Appeal Boards, and the Atomic Safety and Licensing Boards are presented. (JWR)

5386 (RAI-74-9) REGULATORY ADJUDICATION ISSUANCES AND ISSUANCES OF THE BOARD OF CONTRACT APPEALS, SEPTEMBER 1974. (USAEC Technical Information Center, Oak Ridge, Tenn.). Oct 1974. 257p. TIC $2.80.

Issuances received from the U. S. Atomic Energy Commission, the Atomic Safety and Licensing Appeal Boards, and the Atomic Safety and Licensing Boards are presented. (DCC)

5387 (RDT-STATUS-10-74) BIMONTHLY STATUS REPORT: RDT STANDARDS. Summary as of September 30, 1974. (USAEC Division of Reactor Research and Development, Washington, D. C.). 17 Oct 1974. 47p. RSO.

5388 (REG/G-1.89(11-74)) QUALIFICATION OF CLASS IE EQUIPMENT FOR NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Nov 1974. 2p. DRS Free.

This regulatory guide describes a method acceptable to the Regulatory staff for complying with the Commission's regulations with regard to design verification of Class IE equipment for service in light-water-cooled and gas-cooled nuclear power plants. (auth)

5389 (REG/G/1.90(11-74)) INSERVICE INSPECTION OF PRESTRESSED CONCRETE CONTAINMENT STRUCTURES WITH GROUTED TENDONS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Nov 1974. 5p. DRS Free.

This guide describes a basis acceptable to the Regulatory staff for developing an appropriate surveillance program for prestressed concrete containment structures of light-water-cooled reactors with grouted tendons made up of parallel wires or strands (bar-type tendons are not covered). (auth)

5390 (REG/G-9.2(10-74)) INFORMATION NEEDED BY THE AEC REGULATORY STAFF IN CONNECTION WITH ITS ANTITRUST REVIEW OF CONSTRUCTION PERMIT APPLICATIONS FOR NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Oct 1974. 2p. DRS Free.

5391 (REG/G-9.3(10-74)) INFORMATION NEEDED BY THE AEC REGULATORY STAFF IN CONNECTION WITH ITS ANTITRUST REVIEW OF OPERATING LICENSE APPLICATIONS FOR NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Oct 1974. 2p. DRS Free.

This regulatory guide identifies the type of information that the Regulatory staff considers germane for a decision as to whether a second antitrust review is required at the operating license stage. (auth)

5392 LAW AND REGULATIONS FOR THE PIPING IN CONSTRUCTION OF NUCLEAR POWER PLANTS AND THE PROCEDURES FOR APPROVAL. Tamai, T. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo). Haikan Gijutsu; 16: No. 4, 106-112(Apr 1974). (In Japanese).

Among the various laws and regulations pertaining to construction of nuclear power plants in general, the Electric Enterprise Law with its ordinances applies when only the installation of piping in nuclear power plants is considered. The piping regulations are broken down into three aspects: the plans for construction, the inspection of welding, and pre-service inspection. The law with its ordinances is described with emphasis on the procedures for governmental approval as follows: scheme of the Electric Enterprise Law; construction plans, the technical specifications for plant facilities and structures, and aseismic design; welding inspection, the technical specifications for welding, and welding method; and pre-service inspection. (JA)

GENERAL AND MISCELLANEOUS

Civilian Defense

5393 (AD–780578) RESPONSE TO DCPA QUESTIONS ON FALLOUT. Greene, J. C. (Defense Civil Preparedness Agency, Washington, D. C. (USA)). Nov 1973. 50p. (DCPA-RR–20). NTIS $5.50.

Contents are the portion of activity deposited in local fallout; effects of small changes in burst height on the amount of local fallout; effects of soil type and building material on the portion of radioactivity deposited in local fallout; the radioiodine problem–inhalation; detection of fallout by the physical senses; feasibility of developing fallout prediction techniques for operational applications; radioactivity of craters of multi-megaton explosions; interaction of simultaneous surface bursts. (GRA)

Energy Utilization and Economics

Refer also to abstracts 2746, 3435, 3442, and 3443.

5394 (BNL-19266) ENERGY STORAGE FOR UTILITIES VIA HYDROGEN SYSTEMS. Burger, J. M.; Lewis, P. A.; Isler, R. J.; Salzano, F. J.; King, J. M. Jr. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 8p. (CONF-740805-8). Dep. NTIS $4.00.

From 9th intersociety energy conversion engineering conference; San Francisco, California, USA (26 Aug 1974).

An energy storage concept incorporating hydrogen for use on electric utility systems is discussed, where hydrogen is produced electrolytically with off-peak power, stored, and subsequently reconverted to electricity at peak demand periods. An experimental 12.5-kW system now being operated by Public Service Electric and Gas Company is described. The use of metal hydrides for bulk storage of hydrogen is emphasized and several conceptual designs are discussed. Interface, integration and trade-offs between components of the entire energy storage system are considered. A storage system cost of $350 per kW electric at an efficiency of 40 to 55% appears to be a practical goal. (auth)

5395 (BNL-50393) ANALYSIS OF HYDROGEN ENERGY SYSTEMS. Sevian, W. A.; Salzano, F. J.; Hoffman, K. C. (Brookhaven National Lab., Upton, N. Y. (USA)). Feb 1973. Contract AT(30-1)-16. 66p. Dep. NTIS $5.45.

Hydrogen systems analyzed for off-peak electric generation for the transportation systems are off-peak electric power to the year 2000 for reference energy systems; off-peak power shifts from fossil to base-loaded nuclear plants; and off-peak power from all-nuclear electricity. Gasification of coal to hydrogen for transportation systems is studied. Unit energy cost comparisons, residential electricity from substations fueled by nuclear hydrogen, and peak shaving with hydrogen production and reconversion into electricity are considered. (MCW)

5396 (BNWL-1837) MEASURING THE SOCIAL ATTITUDES AND AESTHETIC AND ECONOMIC CONSIDERATIONS WHICH INFLUENCE TRANSMISSION LINE ROUTING. Hendrickson, P. L.; Bahl, R. W.; Gray, B. A.; Maynard, W. S. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1974. Contract AT(45-1)-1830. 153p. Dep. NTIS $7.60.

A methodology previously developed by Battelle, Pacific Northwest Laboratories, for siting nuclear power plants has been adapted to the problem of selecting an optimum electric power transmission line route from among selected alternatives. The unique feature of this methodology is the systematic inclusion of public values into the decision-making process. (auth)

5397 (BNWL-SA-5053) METHANOL FROM FORESTRY, MUNICIPAL, AND AGRICULTURAL ORGANIC RESIDUES. Rohrmann, C. A.; Mudge, L. K.; Hammond, V. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1974. 32p. (CONF-740727-2). Dep. NTIS $4.75.

From engineering foundation conference: methanol fuel; Henniker, New Hampshire, USA (8 Jul 1974).

The potentials for the use of renewable resources, specifically forestry, municipal, and agricultural residues, as primary raw materials for the production of methanol are considered. The basis for such processing would involve the conversion of the residues to a gaseous mixture of suitable composition such that methanol could be obtained by more-or-less conventional synthesis methods. The largest U. S. synthetic methanol plants in operation today produce 200 million gallons per year and this indicates a need for about 1,250,000 tons per year of residues to provide equivalent production. Composition and properties of residues are tabulated for paper; food waste; wood; textiles; leather; rubber; plastic; yard waste; separable inerts such as glass, metal, rock; and dirt. (MCW)

5398 (CONF-740462-1) STATUS AND OUTLOOK FOR ENERGY CONVERSION VIA FUEL CELLS. Ackerman, J. P. (Argonne National Lab., Ill. (USA)). 1974. 5p. Dep. NTIS $4.00.

From UMR-MEC energy conference; Rolla, Missouri, USA (22 Apr 1974).

Advantages of fuel cells, applications of fuel cells, choice of fuels, and the status of fuel cells are briefly discussed. (WHK)

5399 (EPA-660/2-74-067) POLLUTIONAL PROBLEMS AND RESEARCH NEEDS FOR AN OIL SHALE INDUSTRY. Pfeffer, F. M. (Robert S. Kerr Environmental Lab., Ada, Okla. (USA)). Jun 1974. 37p. GPO $0.85.

The oil shale resources and surface stream drainage within the Green River Formation of Colorado, Utah, and Wyoming are presented briefly. The aboveground retorting processes of the Bureau of Mines, Union Oil Company, and The Oil Shale Corporation are described, as are the physical and leaching characteristics of spent shale residues derived from each process. Oil shale retorting in place (in situ) is summarized. The area of major concern, stabilization of spent shale residues, is covered in detail. Other areas of environmental concern discussed are: retort wastewater, process water from shale-oil upgrading, dewatering operations, mineral recovery, and contamination of groundwater by radioactivity. Research needs presented are: a tri-state groundwater report; environmental base line data; an assessment of total environmental impact; pollution control guidelines; effluent limitations; and continuous EPA monitoring. (auth)

5400 (JAERI-M-5642) PRODUCTION OF HYDROGEN FROM WATER USING NUCLEAR ENERGY. A Review. Ueda, R.; Tagawa, H.; Sato, S.; Yasuno, T.; Ohno, S. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 69p. (In Japanese). NTIS (US Sales Only).

Hydrogen, which is inexhaustible in the form of water, could be substituted for petroleum-based fuels and natural gas. Nuclear energy would be the primary energy source for decomposing water. Information available for the production of hydrogen from water is reviewed. The following are described: thermodynamics in the decomposition of water-one-step and multistep processes; thermochemical decomposition process-description of MARK, GE, ANL and EOS processes; nuclear energy as heat source and thermal efficiency in MARK 1 process; radiolysis of water and carbon dioxide; and photolysis of water. (auth)

5401 (LA-UR-74-1111) PROSPECT FOR GEOTHERMAL POWER. Smith, M. C. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 9p. (CONF-740709-2). Dep. NTIS $4.00.

From Power Engineering Society summer meeting and energy resources conference; Anaheim, California, USA(14 Jul 1974).

The relatively small fraction of the earth's crust which is now accessible to man by drilling from the surface contains a supply of thermal energy potentially capable of satisfying the world's total energy needs for many thousands of years. At present, however, only that small fraction of this vast resource is considered useful which exists near the earth's surface in the convenient forms of natural steam or superheated water of relatively low salinity. Research and development are now in progress by both industry and government to learn to use economically the energy contained in the more saline superheated waters, the lower temperature but less highly mineralized natural waters, the combination of heat and temperature and dissolved natural gas contained in geopressured water, and the abundant heat contained in dry hot rock. There is every reason to suppose that the problems associated with utilization of these energy sources will eventually be overcome. The problems are, however, sufficiently formidable to make it unlikely that even ten years from now, more than 1 to 2% of the United States' requirement for electrical power will be satisfied by energy from geothermal sources. With continued technical and commercial development, this fraction should increase to 15 to 20% of the nation's electrical needs by the year 2000, and should be supplemented by a supply of relatively low-grade geothermal heat sufficient to supply a somewhat larger fraction of the nation's nonelectrical energy requirement. (auth)

5402 (LBL-3099) PROCEEDINGS OF THE GEOTHERMAL POWER DEVELOPMENT CONFERENCE, UNIVERSITY OF CALIFORNIA, BERKELEY, JUNE 18, 1974. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1874. Contract W-7405-eng-48. 127p. (CONF-740654-). Dep. NTIS $5.45.

From geothermal power development conference; Berkeley, California, USA (18 June 1974).

The conduct of AEC's research and development activities in geothermal energy is presented. The program plan covering the period FY 1975 through the early 1980's focuses on advanced research and technology and resource utilization projects. (LBS)

5403 (ORNL-NSF-EP-45) SURVEY OF GAS AND OIL BURNERS FOR USE WITH NSF/RANN-ORNL POTASSIUM BOILER. Fraas, A. P.; MacPherson, R. E. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 44p. Dep. NTIS $5.25.

The ORNL boiler tube bundle design is predicted on the use of a cylindrical array of tubes surrounding a long, vertical, cylindrical combustion chamber. The tubes are designed so that the liquid potassium will circulate under natural thermal convection downward from a header drum-vapor separator-expansion tank at the top through a set of downcomers to ring manifolds at the bottom and thence back upward through the tube matrix. The unit is closely integrated with the burner, and its design is heavily dependent on that component. A survey is presented of the various types of burner that might be employed including conventional gas and oil burners, several types of surface combustion gas and oil burners, and catalytic combustion burners together with the possibility of using fluidized bed coal combustion chambers that employ limestone and/or dolomite to absorb most of the sulfur in the coal. A number of conceptual designs for potassium boiler tube bundle and burner configurations are presented. The unit chosen is a modified version of a commercial burner designed for residual fuel oil. The unit will operate on natural gas with the initial combustion carried out with a nearly stoichiometric mixture of natural gas and air diluted with 10 to 25% of recirculated exhaust gas to reduce the flame temperature. It is believed that this unit should more than meet advanced EPA standards for emissions of NO_x, CO, and hydrocarbons. (auth)

5404 (ORNL-TM-4461) HYDROGEN AND EXOTIC FUELS. Michel, J. W. (Oak Ridge National Lab., Tenn. (USA)). Jun 1973. Contract W-7405-eng-26. 39p. Dep. NTIS $5.00.

This report was prepared at the request of the AEC's Division of Reactor Development and Technology for the Federal Power Commission's Technical Aspects Task Force of the Technical Advisory Committee on Energy Conservation. It is intended to emphasize the energy and resource conservation potential in the large-scale use of hydrogen and other synthetic fuels. Although the production of hydrogen from water requires relatively large amounts of energy, due to its clean, efficient conversion some overall energy savings may be possible in some applications. The primary benefit in the use of synthetic fuels would, however, be in resource conservation. (auth)

5405 (ORNL-tr-2827) COAL REFINING. Schilling, H. D. Translated by R. Gregg from Brennst.-Waerme-Kraft; 26: No. 4, 137-140(Apr 1974). 6p. Dep. NTIS $4.00.

A brief review of developments in coal research during the period 1965–1974 is given. Subjects discussed are chemical and physical structure of coals, gasification, liquefaction, desulfurization, coke production, combustion, and mining techniques. (86 references) (SFL)

5406 (SAND-74-0035) MECHANICAL PROPERTIES OF OIL SHALE FROM ANVIL POINT UNDER CONDITIONS OF UNIAXIAL COMPRESSION. Schmidt, R. A.; Schuler, K. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1974. Contract AT(29-1)-789. 29p. Dep. NTIS $4.50.

Unconfined compression tests on oil shale from Anvil Point, Colorado, indicate that the material properties measured are strongly dependent on kerogen content. Increased kerogen levels decrease the fracture strength, yield strength, and Young's modulus, and increase the dilatation, fracture strain, and energy to fracture. A model involving kerogen as a lubricant for crack surface sliding is proposed which accounts for most of the trends seen. The model is supported with direct observation of cracks in fractured specimens. Unloading data are also presented indicating that nonlinear elastic behavior predominates. (auth)

5407 (SAND-74-0041) CHARACTERISTICS AND DEVELOPMENT OF THE TC-765 THERMAL BATTERY. Weaver, C. O. (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1974. Contract AT(29-1)-789. 21p. Dep. NTIS $4.25.

This report presents the design intent, product characteristics, and development history of the TC-765 thermal battery. (auth)

5408 (SAND-74-0146) IN SITU OIL SHALE: A COST SENSITIVITY ANALYSIS. Seager, D. K.; Adams, K. G. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1974. Contract AT(29-1)-789. 54p. Dep. NTIS $5.75.

The analyses of several configurations of an in situ shale oil recovery model indicate that the methods could be economically competitive with above ground recovery schemes. For a 15% discounted cash flow rate of return, a 100,000 BPD in situ plant can produce upgraded oil for $9.80/bbl (1973 dollars). This price can be significantly reduced, however, by research and development efforts which result in modestly improved retort efficiency and retort preparation methods. Such improvements could result in an oil price reduction of more than $2.00/bbl. (auth)

5409 (SAND-74-6018) INVESTIGATION ON SAVONIUS ROTORS AND RELATED FLUID FLOW ENGINES. Bach, G. Translated by C. A. Henkel from Forsch. Geb. Ingenieurw.; 2: No. 5, 218-231(1931). 39p. Dep. NTIS $5.00.

The mode of operation of Savonius and other rotors was experimentally investigated, especially capacity and angular momentum; lift and drag were compared on the basis of form differences. Flow conditions were investigated by means of measurements and flow comparison tests (visibilization of the flow). By these means and by investigating the effect of small changes in test models it was possible to clarify flow conditions and to suggest modifications in construction. The pressure at the rotor axle inside the rotor was also studied. An attempt was made to use the rotor for direct ventilation by axial air supply to the turning rotor. The combined force and work engine that resulted was extensively investigated and it was shown that such a device is very well suited for practical purposes such as vehicle ventilation. (auth)

5410 (SAND-74-8219) SURVEY OF HYDROGEN COMPATIBILITY PROBLEMS IN ENERGY STORAGE AND ENERGY TRANSMISSION APPLICATIONS. Swisher, J. H.; Keeton, S. C.; West, A. J.; Jones, A. T. (Sandia Labs., Livermore, Calif. (USA)). Sep 1974. Contract AT(29-1)-789. 26p. Dep. NTIS $4.50.

A study has been made of current energy storage and transmission applications in which containment of hydrogen is a consideration. The applications discussed are hydrogen storage in hydrides, pressure vessels and pipelines for hydrogen, superconducting electrical transmission lines, and superconducting magnets for storing magnetic energy. It is shown that stainless steels may be needed in some applications for safety, but in many applications lower cost substitutes should be adequate if containment hardware is properly designed and manufactured. (auth)

5411 (SLA-74-0162) IN SITU OIL SHALE CONVERSION AND RECOVERY. Stoller, H. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1974. Contract AT(29-1)-789. 10p. Dep. NTIS $4.00.

The oil shale deposits of the western United States constitute a vast reserve of crude oil, estimated to be in excess of one trillion barrels. The development of in situ conversion and recovery techniques will increase the amount of reserves which can be exploited, reduce the need for underground mining, and diminish the associated environmental disturbances and water requirements. The Sandia Laboratories program will emphasize the development of remote techniques for the establishment of adequate permeability in the oil shale beds as well as the optimization and control of the conversion process. (auth)

5412 (UCID-16630-74-1) LLL-SOHIO SOLAR PROCESS HEAT PROJECT. Report No. 1. Dickinson, W. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1974. Contract W-7405-eng-48. 6p. Dep. NTIS $4.00.

The Sohio uranium plant will require about 500 gpm of water at 140°F, 24 hr/day. This preliminary report outlines a method for providing 50% or more of this requirement using solar energy. A fuel oil boiler will provide the balance. Estimated yearly savings amount to 22,000 bbl of oil and $80,000. Experimental prototypes are being built and tested at LLL. The completed system is expected to be operational by September 1, 1976. Future reports will consider various aspects of the project more specifically. (auth)

5413 (UCRL-76076) ENVIRONMENTAL ASPECTS OF METHANOL AS VEHICULAR FUEL: HEALTH AND ENVIRONMENTAL EFFECTS. Berger, B. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Sep 1974. 15p. (CONF-740727-3). Dep. NTIS $4.00.

From engineering foundation conference: methanol fuel; Henniker, New Hampshire, USA (8 Jul 1974).

An attempt is made to summarize the environmental effects and health consequences that can be predicted as a result of the use of methanol as transportation fuel. The criteria necessary for this evaluation are: the relative effects of the new fuel as compared with gasoline; and a comprehensive study including automotive emissions and all aspects of fuel use including distribution, industrial exposure, consequences of miscellaneous home use as well as effect on terrestrial and aquatic ecosystems. Results are shown of exhaust analysis for hydrocarbons and aldehydes with methanol fuels. A toxicological comparison of methanol and gasoline is tabulated. (MCW)

5414 (UCRL-76150) APL LANGUAGE AS A POWERFUL ENGINEERING DESIGN TOOL. McKay, J. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Oct 1974. 14p. (CONF-741001-20). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

APL is a high-level language that affords enormous time savings in computer programming and debugging at all levels of problem sophistication. Using APL as a super calculator, the novice can solve complicated algebraic expressions after only a few hours of instruction and practice. APL can also be learned a piece at a time without the user having to be concerned about inadvertently causing the system to bomb. Many engineers who should be using computers have been turned off by their initial, unpleasant experiences in handling input-output. Yet in APL, input-output problems, the biggest single barrier to achieving proficiency in Fortran, are practically nonexistent. Also, design problems that require only an hour or two on a desk calculator, but have to be repeated more than once or twice, can be programmed advantageously in APL. (auth)

5415 ENERGY AND RAW MATERIALS FOR THE CHEMICAL INDUSTRY. Finniston, H. M. (British Steel Corp., Port Talbot, Eng.). Chem. Ind. (London); No. 17, 677-682(7 Sep 1974).

From annual meeting of the Society of Chemical Industry; Brussels, Belgium (2 Jul 1974).

This review relates principally to the steel making industry. Present day steelmaking processes are reviewed, including the current pattern of energy consumption and the efficient use of energy. In the long term it is thought that the logical course for the steel industry to take will be to reserve fossil fuels for use solely as ore reductants, while providing the required energy from nuclear reactor sources. The high temperatures required for the hot metal steelmaking process are beyond the reach of present or foreseeable reactor technology, but direct nuclear heat could be linked with steelmaking via the lower temperature direct reduction process followed by electric steelmaking using power generated from the same nuclear reactor. High temperature gas cooled reactors of the Dragon type have already proved capable of achieving a core outlet gas temperature of about 1000°C, which with suitable heat exchanger design would be sufficient to produce a process temperature of about 800°C for the generation of reducing gases. Initially a natural gas feedstock would be used, but as reserves declined oil or coal feedstocks could be used to generate the reductants, or ultimately perhaps H_2 produced thermochemically or electrolytically from water using nuclear power. Such a project would be suitable for international cooperation. (UK)

Law

Refer also to abstracts 3323, 3325, 3333–3343, 3345–3347, 3354, 3357, 3703, and 5425.

5416 (AEC-tr-7550) REGULATION ON PROTECTION AGAINST DAMAGE BY X RAYS (X-RAY REGULATION: RoeV). Translated from Bundesgesetzblatt, Teil 1; No. 18, 173-192(1973). 32p. Dep. NTIS $4.75.

Regulations in the German Federal Republic applicable to the radiation protection of patients during diagnostic radiographic examinations are reviewed. (CH)

5417 (AED-CONF-73-670-002) INFLUENCE OF THE ENVIRONMENTAL FUNCTION OF THE ATOMIC ENERGY LAW ON THE CONCEPTS OF REACTOR CONSTRUCTION, ELECTRICITY PRODUCTION BY MEANS OF NUCLEAR POWER PLANTS, TRADE WITH REACTOR COMPONENTS, NUCLEAR FUELS, RADIOISOTOPES, AND RADIOLOGICAL DEVICES. Pfaffelhuber, J. K. (Bundesministerium des Innern, Bonn (F.R. Germany)). 1973. 10p. (In German). INIS.

From working meeting on international and European law; Goettingen, F.R. Germany (22 Nov 1973).

With abstract.

The purpose and functions of the Atomic Energy Law with regard to the protection of the environment are related to another aspect of this Act, namely the promotion of nuclear energy generation. The Atomic Energy Law is presented as an example of a well-timed and efficient means to influence and control nuclear activities which might adversely affect or even present serious risks to the environment. Due to the fact that the Atomic Energy Law can be used as an efficient tool in this field (and this is being done much more purposefully since the 1960's) nuclear power generation has become a branch of technology whose safety standard is much higher than that of conventional industries. (GE)

5418 (AED-CONF-74-221-001) TASKS AND RESPONSIBILITIES OF THE AUTHORIZED PHYSICIAN. Moehrle, G. (Kernforschungszentrum Karlsruhe (F.R. Germany). Abt. Strahlenschutz und Sicherheit). 1974. 9p. (In German). INIS.

From 15th annual meeting on "the authorized physician within the meaning of the radiation protection laws;" Karlsruhe, F.R. Germany (14 Jun 1974).

The tasks and responsibilities of the authorized physician laid down in currently existing provisions, regulations, and decrees are discussed in brief and possible amendments are pointed out. (GE)

5419 (EPA-R-3-73-033) WATER QUALITY CRITERIA, 1972. (National Academy of Sciences–National Academy of Engineering, Washington, D. C. (USA). Committee on Water Quality Criteria). Mar 1973. 594p. GPO $12.80.

Water quality characteristics are presented for designated uses based on scientific information available. The recommendations are intended for use as guidelines to be used in conjunction with a thorough knowledge of local conditions for establishing water standards for various uses. Criteria are included for water for use for: recreation and aesthetics; public water supplies; freshwater aquatic life and wildlife; marine aquatic life and wildlife; agricultural uses; and industrial water supplies. A glossary, conversion factors, and author and subject indexes are included. (2910 references) (CH)

5420 (JPRS-63269, pp 2-13) RADIATION PROTECTION LAWS AND REGULATIONS DESCRIBED. Ifflaender, G. 23 Oct 1974. Translated from Kernenergie; 17: 248-253(Aug 1974).

In translations on eastern Europe, scientific affairs, No. 434.

The content and objectives of GDR radiation protection laws, whose object it is to prevent harm to persons and material objects, are reviewed. An explanation is given of the responsibility of the State Office for Atomic Security and Radiation Protection for overseeing radiation protection activities on a republic scale and for licensing and radiation protection monitoring. Within the institution the manager, the managerial staff, and the radiation protection monitor are responsible for compliance with and supervision of radiation protection measures. In the matter of liability for radiation damages, the principle of liability from sources of increased risk applies which assures increased protection of employees in nuclear installations and of those having access to radioactive material. Basic radiation protection regulations in the GDR are based on recommendations of the International Radiation Protection Commission. (auth)

5421 CURRENT MEMBERSHIP OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES. Joint Committee on Atomic Energy Membership, Publications, and Other Pertinent Information Through the Ninety-Third Congress, First Session, August 1974. Washington, DC; Joint Committee on Atomic Energy (1974). 69p. GPO $0.70.

Information on unclassified atomic energy data includes a comprehensive list of the unclassified publications issued by the Joint Committee since its formal establishment by Congress. Included are references to and brief descriptions of atomic energy legislation that has been enacted since the first such enactment in 1946; a complete list of the legislative reports of the committee; a tabulation of committee reports on agreements for cooperation; and the names and locations of AEC depository libraries. Also included are tables tracing the membership of the committee and the Commission from their inception; a table reflecting the length of service on the committee and its various subcommittee's organization and functions. A report to Congress on the activities and accomplishments of the committee during the 93rd Congress is included. (MCW)

5422 RADIOGRAPHS UNDER X-RAY REGULATIONS. Zahnaerztl. Mitt.; 17: 248-252(Dec 1973). (In German).

The primary provisions of new x-ray regulations and their significance for the radiologist are outlined. The records which must be maintained under these regulations are also given. (JSR)

Management

Refer also to abstract 3446.

5423 (BNWL-SA-3075(DRAFT)) TRANSURANIUM RADIONUCLIDES. A Manual of Good Practice. Unruh, C. M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1970. 103p. Dep. NTIS $8.25.

This manual of good practice provides radiation protection guidance for working with transuranium radionuclides based on the experience of the AEC contractor laboratories and private industry. The manual provides specific information that can be useful in establishing and administering safe programs for working with transuranium radionuclides. Also, the manual provides those relatively inexperienced in working with transuranium radionuclides with the background of experience that has been developed by other users. The manual presents and discusses good practices that should be observed by management, technical staff, and technicians. Usually it will be clear where the responsibility for the establishment of a good practice lies; however, the execution of good practices commonly requires a joint effort. Management has the responsibility to provide, by some mechanism, any necessary training and instruction for the staff in addition to providing the facilities, equipment and tools to perform work with transuranium radionuclides safely. Planning for emergencies is usually a management responsibility. The staff is charged with the responsibility to work safely and to make the proper use of the facilities, equipment and tools provided. No one should, and no one should be expected to perform any assignment or work that violates basic safety and good work practices and, consequently may lead to physical harm to any individual or damage to equipment or facilities. In transuranium radionuclide work, as in any undertaking, safety and good work practices ultimately become the personal responsibility of each individual. (auth)

5424 (DEU-73-18) RESEARCH AND DEVELOPMENT WORK IN 1972. Scientific Report on Results. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). 1973. 299p. (In German).

The report describes the KFA research and development work carried out in 1972. In the beginning of the index, the subdivisions according to institute and plant centers are shown as well as those research and development plans with a given code number. In the description of the institute, a summarizing report is given on the main interests of the institute's work, on the plans, on the infrastructure of the institute and the cooperation with other research plants. Then the results of the individual research and development plans are given. In the text of the FE description, the literature, lecture, and patent specification at the end of the description are indicated. Here a distinction is made between publications, lectures, and internal reports. A list of publications and lectures is contained. (GE)

5425 (JPRS-63269) TRANSLATIONS ON EASTERN EUROPE, SCIENTIFIC AFFAIRS, NO. 434. (Joint Publications Research Service, Washington, D. C. (USA)). 23 Oct 1974. 53p. NTIS.

Seven articles are included concerning the development of and progress in the various theoretical and applied scientific disciplines and technical fields; and the administration, structure, personnel, and research plans of leading east European scientific organizations and institutions, particularly the academies of sciences. A separate abstract was prepared for one paper. (CH)

For an abstract of an individual paper see: 5420.

5426 (TID-26653) REPORTING AND RECORDING OF OCCUPATIONAL RADIATION EXPOSURE INFORMATION IN THE CENTRAL REPOSITORY. Annual Reports, 1–5. (USAEC Division of Operational Safety, Washington, D. C.). 1972. 70p. Dep. NTIS $6.75.

A system to provide for the efficient exchange of occupational radiation exposure information between and among Federal, state and local agencies and organizations, as well as between employers, employees and their authorized designees, has been established through the development and operation of the central records repository at Oak Ridge, Tennessee. Based upon experience to date in the development of the system, the feasibility of a central repository has been established. Identification and occupational radiation exposure information has been incorporated in the central repository on a total of 122,731 individuals reported by certain AEC licensees, contractors, and others. Of this number, reports of annual exposure information have been submitted on 63,969 individuals and reports of cumulative exposure information, submitted upon termination of employment or work assignment, on 58,762 individuals between February 1969 and December 31, 1972. In Calendar Year 1972, AEC contractors and covered licensees reported monitoring 203,210 individuals. Of this number, 197,735 (97.3%) received no exposure or an annual whole-body exposure of less than 1.25 rem, the level established for reporting exposure information to the central repository. (CH)

5427 (UCRL-51656) CONCEPT FOR AN ATMOSPHERIC RELEASE ADVISORY CAPABILITY. Dickerson, M. H.; Knox, J. B.; Cohen, J. J.; Orphan, R. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Oct 1974. Contract W-7405-eng-48. 16p. Dep. NTIS $4.00.

The purpose of this study is to develop a concept for an advisory service that could be used to assess the consequences of an accidental release of radioactivity or other toxic materials to the atmosphere. This capability would be used in the form of advisories to AEC sites and facilities and eventually could be applied to licensee sites. The major theme of the proposed Atmospheric Release Advisory Capability is to provide estimates of the effects of atmospheric releases of hazardous materials as rapidly and accurately as possible. (auth)

5428 (WASH-1190(1973)) NATIONAL SURVEY OF COMPENSATION PAID SCIENTISTS AND ENGINEERS ENGAGED IN RESEARCH AND DEVELOPMENT ACTIVITIES, 1973. (Battelle Columbus Labs., Ohio (USA)). 1 Nov 1973. Contract W-7405-eng-92. 248p. Dep. NTIS $15.50.

The results of the sixth annual survey conducted in 1973 on compensation paid to scientists and engineering personnel engaged in research and development in the U. S. are reported. The survey utilized the maturity or age-wage approach under which salary data would be related to years since receipt of degree or chronological age. The universe of scientists and engineers was divided into the five sectors of industry, nonprofit research institutes, federally-funded contract R & D centers, Federal Government, and educational institutions. (MCW)

5429 (WASH-1349) REPORT TO THE ATOMIC ENERGY COMMISSION AND THE NATIONAL SCIENCE FOUNDATION BY THE COMMITTEE TO REVIEW U. S. MEDIUM ENERGY SCIENCE. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.). Sep 1974. 178p. Dep. NTIS $7.60.

At the request of the Atomic Energy Commission and the National Science Foundation, we have studied the medium energy science program of the United States and have prepared recommendations on program priorities for the years FY 75 through FY 79 at several levels of effort. Our observations and recommendations are presented in this report. The study has been carried out with the joint support of the two agencies during the period March 1 to July 31, 1974. (auth)

5430 (WASH-1350-R6) SIXTH ANNUAL REPORT OF THE OPERATION OF THE U. S. ATOMIC ENERGY COMMISSION'S CENTRALIZED IONIZING RADIATION EXPOSURE RECORDS AND REPORTS SYSTEM. (USAEC Division of Operational Safety, Washington, D. C.). Sep 1974. 20p. Dep. NTIS $4.00.

During the six calendar years that the U. S. Atomic Energy Commission central repository of personnel occupational radiation exposure information has been in operation, individual identification and occupational exposure information has been incorporated in the repository on a total of approximately 146,000 monitored personnel reported by certain AEC licensees, contractors, and others. Of this number, individual annual exposure reports for the period 1968 to 1973 have been submitted on approximately 68,500 persons. During the period 1969 to 1973 individual reports of cumulative exposure information have been submitted upon termination of employment or work assignment for approximately 77,500 persons. A comparative analysis of AEC contractor and licensee annual exposure experience for the six year period 1968 to 1973 is included. During CY 1974, 10 CFR 20.407 was amended to require covered licensees to submit annual statistical exposure information on monitored individuals in lieu of identification and exposure information for persons whose annual exposure exceeded applicable quarterly limits. A similar change in the reporting requirements of AEC Manual Chapter 0525, applicable to AEC and AEC contractors, is in preparation. (CH)

Mathematics and Computers

Refer also to abstract 5000.

5431 (AERE-R-7789) DEVELOPMENT OF A MODEL FOR HORIZONTAL ANNULAR FLOW. Hutchinson, P.; Butterworth, D.; Owen, R. G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Sep 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

Work is proceeding on the development of a model for horizontal, annular, two-phase flow. The model involves the following: an analysis of the droplet diffusion in the gas phase that allows for the variation of droplet entrainment around the tube perimeter but does not allow for gravity forces on the drops; drainage in the film due to gravity and allowance is made for turbulence in the film but not for the effects of waves; the entrainment correlation developed at Harwell; a prediction of gas phase hydrodynamics and axial shear stress on the film by a technique that allows for the different roughnesses around the tube due to waves; and an empirical relationship between film thickness and effective roughness. Combining these models with a film mass continuity equation permits prediction of the full flow hydrodynamics. (auth)

5432 (BNWL-B-361) HETRAN: A SUBPROGRAM PACKAGE FOR PREDICTING THE HEAT TRANSFER ACROSS THE SURFACE OF A NATURAL BODY OF WATER. Daniels, D. G.; Oster, C. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1974. Contract AT(45-1)-1830. 62p. Dep. NTIS $5.45.

A computer subprogram HETRAN was developed for prediction of atmospheric heat exchange across the air-water interface of a natural water body. The program uses standard meteorologic data and analytic-empirical relationships to calculate the component energy fluxes. Included in the general heat budget are net shortwave radiation, net atmospheric radiation, back radiation, evaporative heat loss, and convective loss or gain at the air-water interface. The program is capable of predicting diurnal patterns and long term temperature variations. The subprograms are designed so that they may be easily coupled to generalized programs for far-field temperature predictions. (auth)

5433 (CEA-CONF-2626) DYNAMIC MOS MEMORY WITH 4096 BITS. Blanchet, F.; Mackowiak, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 18 Dec 1973. 13p. (In French). (CONF-731095-1). Dep. NTIS (US Sales Only) $4.00.

From international colloquium on memory, techniques, organization and use; Paris, France(23 Oct 1973).

5434 (CEA-CONF-2627) ORGANIZATION AND USE OF BUBBLE MEMORIES. Coeure, P.; Jouve, D.; Lagoutiere, J.; Mauduit, D.; Randet, D. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 30 Nov 1973. 9p. (In French). (CONF-731095-3). Dep. NTIS (US Sales Only) $4.00.

From international colloquium on memory, techniques, organization and use; Paris, France (23 Oct 1973).

5435 (CEA-CONF-2628) CHARACTERISTICS OF MEMORIES WITH MI_1I_2S TRANSISTORS. Borel, J.; Mackowiak, E.; Le Goascoz, V. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 22 Oct 1973. 20p. (In French). (CONF-731095-2). Dep. NTIS (US Sales Only) $4.00.

From international colloquium on memory, techniques, organization and use; Paris, France(23 Oct 1973).

5436 (CEA-CONF-2650) IMAG 2 PROGRAM FOR THE CAD OF ELECTRONIC CIRCUITS: BIPOLAR AND MOSFET MODELS AT L.E.T.I. Borel, J.; Baylac, B.; Mackowiak, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 31 Oct 1973. 57p. (CONF-7306105-1). Dep. NTIS (US Sales Only) $6.00.

From meeting in computer-assisted thinking; Louvain, Belgium (4 Jun 1973).

5437 (CERN-74-19) SUPERMUX: A MULTI-HOST FRONT END CONCENTRATOR SYSTEM FOR ASYNCHRONOUS CONSOLES. Bruins, T.; Olofsson, K. S.; Palandri, E. M.; Segal, B.; Slettenhaar, H. J.; Strack-Zimmermann, H. (European Organization for Nuclear Research, Geneva (Switzerland)). 8 Sep 1974. 85p.

The report describes a front-end concentrator/multiplexor system SUPERMUX for asynchronous time-sharing consoles operating on a minicomputer that was put into operation at CERN. The concentrator/multiplexor will control up to 36 consoles at speeds between 110 and 9600 bits per second and has the capability of dynamically connecting these consoles to several large host computers. The hardware and software developed at CERN, and the diagnostic and simulation techniques used to test the system are described. The system runs on an HP 2100 minicomputer, and a special-purpose microcode is used to optimize console handling and facilitate the implementation of the system. The host computers are the CDC 6000 series computers using the INTERCOM time-sharing system. (auth)

5438 (CIC-F-3-001) MINIMIZE LINEAR RESIDUALS. von Holdt, R. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1969. 27p. Dep. NTIS $4.50.

For a given matrix A and vector Y, MLR uses the method of Householder reflections to minimize the sum of the squares of the elements of R, where $R = Y - AX$. In the special case when A is square, MLR solves the matrix equation $AX = Y$. To save work already done on a previous call to MLR, entry MLRA may be called to reuse MLR for the same A but a new Y. MLRE computes the diagonal elements of $(A^*A)^{-1}$, the inverse matrix of the normal equation, when A is not square. (auth)

5439 (COO-2383-0014) MULTIRATE METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS. Gear, C. W. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Sep 1974. Contract AT(11-1)-2383. 12p. (UIUCDCS-F-74-880). Dep. NTIS $4.00.

Multirate methods have often been considered for integrating systems in which one part changes much more rapidly than another, but little theoretical study has been made on the accuracy and stability of such methods. These comments suggest some of the problems that might be involved, and some ways in which the methods can be analyzed. (auth)

5440 (IEA-337) ANALYSIS OF CRACKED STRUCTURES. Davidson, I. (Instituto de Energia Atomica, Sao Paulo (Brazil)). May 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

Stable crack systems may exist in reinforced concrete structures. The paper presents a brief review of the general problem and derives very simple methods of analysis. Some elaborations are described, together with methods of optimizing the calculations. Analytical results are compared with experiments. Application of the method may be made to other crack systems. (auth)

5441 (ITF-74-96P) LIGHT ABSORPTION AND DISPERSION BY IONIC CRYSTALS IN THE EXCITON REGION WITH MANY PHOTON PROCESSES TAKEN INTO ACCOUNT. Tkach, N. V.; Nitsovich, V. M.; Lubchenko, A. F. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 29p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The effect of many-phonon processes on the structure and the temperature genesis of spectra of light absorption and dispersion by ionic crystals in the exciton region is investigated with linear and quadratic (in phonon operator) terms in the exciton-phonon interaction operator simultaneously taken into account. The real and imaginary parts of the mass operator are calculated as a function of frequency and temperature and the light absorption and dispersion curves for varying the temperatures are obtained. (tr-auth)

5442 (KFK-EXT-8/74-2) DYNAMIC DATA BLOCK MANAGEMENT IN FORTRAN. Schumann, U. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). Aug 1974. 34p. (In German). Dep. NTIS (US Sales Only) $4.75.

A subprogram package is made available for the dynamic management of large data sets in FORTRAN programs. This allows storage of those data that do not fit into the main core memory in an external direct access data file. The subprogram package expects the data set to be subdivided into blocks of equal lengths. Individual subprogram entries allow space in core memory to be made available for a new block or for an earlier used block. Blocks are not moved until they are released or deleted by call of some other subprogram entries. The subprogram package automatically transfers previously released blocks to the external file if the space in the core memory is not sufficient for blocks to be newly made available. It is assumed that the blocks are processed in a cyclic sequence; hence, the block released last will be removed first. The subprogram package is programmed in FORTRAN IV and ASSEMBLER for application in FORTRAN programs. The ASSEMBLER routines allow automatic adaptation to be made to the space available in the core memory and on the disk. If this comfort is not to be used, they can be replaced by a few FORTRAN statements. The report contains a description of the application and the logic of the routines and the lists of the FORTRAN routines. (tr-auth)

5443 (KFK-EXT-8/74-3) REGENT: FIFTH SEMIANNUAL PROGRESS REPORT, OCTOBER 1973-MARCH 1974. Schlechtendahl, E. G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). June 1974. 38p. (In German). Dep. NTIS (US Sales Only) $5.00.

The project REGENT (German acronym for CAD, Computer aided design) was started in early 1972 by the Institut fuer Reaktorentwicklung. The fifth semiannual progress report summarizes the results to March 31, 1974 with respect to the development of the REGENT system nucleus. (tr-auth)

5444 (JUL-1065-HT) FIES: A FLEXIBLE INFORMATION-RESEARCH SYSTEM. Kotte, U. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). May 1974. 66p. (In German). Dep. NTIS (US Sales Only) $6.50.

5445 (JUL-1094-MA) SYMMETRICAL WILF QUADRATURE FORMULAS. Engels, H.; Eckhardt, U. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Angewandte Mathematik). Aug 1974. 26p. (In German). Dep. NTIS (US Sales Only) $4.25.

Using a new characterization for WILF quadrature formulae given by Engels, these formulae are computed for the interval [-1, 1] up to 32 nodes with 25 significant digits. A description is given on how to perform the calculation of nodes and weights of these formulae. Nodes and weights as well as FORTRAN-subroutines for WILF-quadrature are listed, which can be implemented immediately. (tr-auth)

5446 (KFK-PDV-25) VIEW OF THE COSTS OF THE REALIZATION OF DATA STRUCTURES, PART 1. Winkler, J.F.H. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F. R. Germany)). Jul 1974. 50p. (In German). Dep. NTIS (US Sales Only) $5.50.

In generating operating systems adaptively the optimal version for a special application is to be selected out of a set of versions of operating systems. One feature in which these versions differ is the realization of the necessary data structures. In order to be able to compare the different realizations of data structures, the costs that arise by using the data structures are considered. These are the costs of the memory for the data and the memory for the routines to manipulate the data and the costs of the time required to execute these routines. The present part 1 deals with the realization of elementary data, records, and arrays. (tr-auth)

5447 (LA-5742-MS) SURFACES OF REVOLUTION WITH VARIOUS NORMAL INTERSECTION PROPERTIES. Everett, C. J.; Orr, S. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1974. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

The way in which the normals to a surface of revolution intersect the axis of symmetry is of interest both mathematically and physically. Those surfaces for which the intersection point has certain specified properties of distance, or of uniformity, are determined. Some of these properties determine the central conics, while others lead to generating curves apparently new. Routines are included for determining the polar coordinates of those that are ellipse-like and, hence, relevant to design. (auth)

5448 (LA-UR-74-1566) COMPUTER SCIENCE AND SERVICES DIVISION OF THE LOS ALAMOS SCIENTIFIC LABORATORY. Dorr, F. W. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 6p. (CONF-741001-9). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

The Computer Science and Services Division (C-Division) of LASL are described. The computer hardware is treated in some detail, and the associated software and applications activities are outlined. (auth)

5449 (ORNL-NSF-EP-75) TVAMAP: A PROGRAM FOR PLOTTING GEOGRAPHICALLY DISTRIBUTED DATA. Stephenson, R. L. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 35p. Dep. NTIS $4.75.

The program TVAMAP has been written to produce Calcomp displays of geographically distributed data. The program provides for the display of a geographic outline (state, county, watershed, etc.) and of the locations of data points. The displays may be produced in any of several map projections. (auth)

5450 (ORNL-NSF-EP-76) SYMCON: A PROGRAM FOR CONVERTING LATITUDE AND LONGITUDE TO ORTHOGONAL COORDINATES. Stephenson, R. L. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 38p. Dep. NTIS $5.00.

The program, SYMCON, has been written to convert from latitude and longitude to distances, x and y, in inches as they would be found on a map of specified scale in any of several projections. The primary use of the program is to provide a convenient source of input data for the graphic display program SYMAP. (auth)

5451 (RISO-M-1722) HUMAN DATA PROCESSOR AS A SYSTEM COMPONENT BITS AND PIECES OF A MODEL. Rasmussen, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jun 1974. 52p. Dep. NTIS (US Sales Only) $5.75.

During recent years the systems engineer designing control rooms for industrial process plants has been faced with complex human factors problems. In conventional control rooms the arrangement of meters, recorders, and control keys on the control desk and the choice of properly designed knobs and dials are the chief objectives for human factors consideration. The advent of computer-controlled display systems with the variety of modes for data conditioning and presentation available to support the operators calls for an integrated systems design. The formatting and encoding of displays should be properly matched to the characteristics of human mental data processing, and close interaction is needed between systems engineering expertise and psychology. For information and results from another professional area to be identified and digested an interdisciplinary working hypothesis or reference frame is needed, and the present report describes such a preliminary model aiming at the support of future reading, discussions, and experiments. Using as reference the tasks of process operators, the report discusses the role of the perceptive generalizations, dynamic modeling, and motor coordinative functions of subconscious data processing, and of the different types of mental models and procedures used in conscious data processing. (auth)

5452 (RT/ING-(74)10) VERIFICATION OF THE FINITE ELEMENT COMPUTER CODE SAFE-2D. Massini, G.; Zaccarelli, P. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Feb 1974. 163p. (In Italian). Dep. NTIS (US Sales Only) $11.25.

A bidimensional stress analysis of some structures was performed by the finite element code SAFE-2D; a double precision version of SAFE-2D was developed and checked. The results were compared with those obtained by theoretical or experimental analysis. (tr-auth)

5453 (SAND-74-5180) COMPUTER PROGRAM FOR THINNING LARGE SETS OF DATA. Hochrein, G. J.; Larson, D. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 5p. (CONF-741001-18). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

A computerized method designed for selectively thinning large sets of data is described. The output of the computer program is a smaller number of data points that linearly approximate all the original data to a specified accuracy. Computer-generated plots that indicate how well the final, thinned data represent the original data are included in the paper. The program was developed to reduce excessive quantities of computer-generated pressure distribution data to a practical size that can be used as input to aerodynamic heat transfer codes. Two examples that illustrate the thinning procedure are presented. (auth)

5454 (SAND-74-5486) QMESH: A SELF-ORGANIZING MESH GENERATION PROGRAM. Jones, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 7p. (CONF-741001-19). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

QMESH is a recently developed FORTRAN program for producing two dimensional meshes for input to finite element analysis programs using quadrilateral elements. Bodies are described to QMESH as a collection of regions defined by their boundaries. These boundaries are described using a natural, hierarchal system of sides, lines, and points. QMESH develops a mesh for each region independently, using little or no user-provided information other than the boundary descriptions. The description of the entire mesh is assembled during a final bandwidth minimizing phase performed by QMESH's companion program, RENUM. The mesh generating process for each region begins by mapping an appropriate mesh from the unit square to the interior of the region. This mesh is then smoothed and perhaps restructured using an iterative process in which two types of local structural modifications and mesh smoothing are successively performed. This whole process proceeds automatically. (auth)

5455 (SAND-74-5543) SALOGS: A 6600 PROGRAM TO PERFORM DIGITAL LOGIC SIMULATION AND FAULT DIAGNOSIS. Case, G. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 8p. (CONF-741001-14). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

One of the essential programs that must be present in a CAD library is a program to simulate digital logic circuits prior to layout and fabrication. The SALOGS program, developed by Sandia Laboratories, performs logic simulation and test sequence evaluation. The network setup procedure and simulation language for the program are described. The capabilities of the program to evaluate a test sequence are discussed. (auth)

5456 (SAND-74-5544) COMPUTER AIDED DESIGN OF MOS INTEGRATED CIRCUITS. Gwyn, C. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 10p. (CONF-741001-17). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Computer Aided Design (CAD) techniques provide the circuit designer with a complete set of computer programs to aid in a step by step design of an integrated circuit (IC). A list of computer software based on circuit design using a standard cell library and a typical design sequence are presented for complete custom MOS digital IC design from logic description of mask layout. Several integrated circuit designs using the system are discussed. (auth)

5457 (SAND-74-6019) REGULARITY OF DIFFUSION IN TERNARY ALLOYS AND THE KINETICS OF FORMATION OF TRIPLE COMPONENT COATINGS. Shcherbedinskii, G. B. Translated from Zashch. Pokrytiya Metal.; No. 6, 38-44(1972). 14p. Dep. NTIS $4.00.

Mathematical solutions are examined for simultaneous and consecutive diffusion saturation and have been used as a technological procedure. The following cases are examined: simultaneous saturation of a ternary alloy by two elements; saturation of a two-component alloy by a third element; simultaneous removal of two elements from a three-component alloy; and surface formation of a layer of a new phase, different from the initial phase. (MCW)

5458 (SLA-74-5320) EFFICIENT, SCALE-INVARIANT DETERMINATION OF STARTING STEP SIZES FOR HIGH-ORDER INTEGRATORS. Williams, D. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 10p. (CONF-741101-3). Dep. NTIS $4.00.

From ACM annual conference; San Diego, California, USA (11 Nov 1974).

Many routines for solving differential equations require the user to specify an estimate of the initial step size. A means of estimating an appropriate value automatically is introduced. Strong emphasis is placed on the need for scale invariance in making such estimates, and the importance of scale and matters equivalent to scale in estimating the order of magnitude of the appropriate starting step size is reviewed. The response to scale of integrators employing the error per unit step concept of error control is discussed and it is concluded that the procedure should not be used on such integrators, if the latter should be used at all. Test results are cited. (auth)

5459 (SLL-74-0022) ORGANIZATION OF GNATS: A GENERAL NONLINEAR ANALYSIS COMPUTER PROGRAM FOR TWO-DIMENSIONAL STRUCTURES. Young, R. C.; Callabresi, M. L. (Sandia Labs., Livermore, Calif. (USA)). Oct 1974. Contract AT(29-1)-789. 85p. Dep. NTIS $6.00.

GNATS is a finite element computer program designed for the general nonlinear analysis of two-dimensional static structures. Contained in this report is a description of the program organization. Flow charts, calling trees, and the central memory allocation maps are used to describe the initialization, load path preparation, and solution phases of the program. Descriptions of data transfers to disc, tape, and extended core storage are also provided. For reference during program modification, a glossary of all significant variables and a description of all subroutines are included. The GNATS program was written in FORTRAN IV for use on the Control Data 6600. (auth)

5460 (SU-326-P30-31) ALGORITHMS FOR SEPARABLE NONLINEAR LEAST SQUARES PROBLEMS. Ruhe, A.; Wedin, P. A. (Stanford Univ., Calif. (USA). Dept. of Computer Science). Jul 1974. Contract AT(04-3)-326. 51p. Dep. NTIS $5.75.

Iterative algorithms of Gauss-Newton type for the solution of nonlinear least squares problems are considered. They separate the variables into two sets, in such a way that in each iteration, optimization with respect to the first set is performed first, and corrections to those of the second after that. The linear-nonlinear case, where the first set consists of variables that occur linearly, is given special attention, and a new algorithm is derived that is simpler to apply than the variable projection algorithm as described by Golub and Pereyra, and can be performed with no more arithmetical operations than the unrestricted Gauss algorithm. A detailed analysis of the asymptotical convergence properties of these three algorithms is performed, and it is found that they have comparable rates of convergence, and all converge almost quadratically for almost compatible problems, as opposed to simpler separation schemes that always converge only linearly. A series of numerical tests are reported, both on artificial and realistic data, and it is found that the new algorithm is at least as good as any of those already known, and as the theory has predicted. Typical applications are least squares approximation by exponential or rational functions, and overdetermined nonlinear systems of equations; examples are given of both. It is indicated how the new algorithm can be extended to the fully nonlinear case, and nonlinear orthogonal curve fitting is discussed as an example of that. (auth)

5461 (SU-326-P30-32) SOLUTION OF LARGE, STRUCTURED LINEAR COMPLEMENTARITY PROBLEMS. III. Technical Report 74-7. Cottle, R. W.; Golub, G. H.; Sacher, R. S. (Stanford Univ., Calif. (USA). Dept. of Computer Science). Jun 1974. Contract AT(04-3)-326. 90p. Dep. NTIS $7.50.

A general linear complementarity problem is considered in which the matrix is not necessarily tridiagonal but may be block tridiagonal. It is assumed to be Minkowski, in which M may be partitioned into submatrices M_{ij} $(i, j = 1, 2, \ldots, m)$ such that M_{ii} is a Minkowski matrix of order $n_i = 1, 2, \ldots, m$; $M_{ij} \leqq 0$ (elementwise) if $i \neq j$; M has positive principal minors; and $M_{ij} = 0$ if $|i-j| > 1$. Matrices satisfying the last condition alone are known as block tridiagonal matrices. (MCW)

5462 (SU-326-P30-34) NUMERICAL ANALYSIS. Progress Report, July 1, 1973–August 15, 1974. Golub, G. H. (Stanford Univ., Calif. (USA)). 1974. Contract AT(04-3)-326. 11p. Dep. NTIS $4.00.

Technical reports and publications completed during the period are listed. Work in progress is reported and includes linear system problems; numerical solution of two-point boundary value problems; difference methods for the solution of singular perturbation problems; and non symmetric sparse eigenvalue problems. (MCW)

5463 (SU-326-P30-35) COMPUTATIONAL APPROACH TO SIMULTANEOUS ESTIMATION. Jennings, L. S. (Stanford Univ., Calif. (USA). Dept. of Computer Science). Sep 1974. 16p. Dep. NTIS $4.00.

The problem of estimating the parameters of economic models is studied from a computational point of view. The user of software packages may not know the limitations of computer arithmetic. There is concern with using the best numerical techniques and with specifying just what numerical error information such a package for simultaneous estimation should return to the user. Also because models can become large it is necessary to look for ways of conserving space. Several techniques for three-stage least squares are summarized that take into account limitations of space and accuracy. (auth)

5464 (TRG-Report-2502(S)) EPIMETHEUS (HELLFIRE 1): AN X-RAY DIFFRACTION DATA VALIDATION PROGRAM. Eastham, M. A.; Ferguson, I. F.; Hughes, T. E. (UKAEA Reactor Group, Springfields). Aug 1974. 74p. Dep. NTIS (US Sales Only) $6.75. UK £1.50.

The Fortran program EPIMETHEUS is described. The program orders, validates, and checks data output as punched cards from PROMETHEUS, RFL's automatic x-ray diffractometer. The validated data are placed in a named file on disc for subsequent use by other programs in the HELLFIRE suite of Fortran x-ray powder diffraction data processing programs. (auth)

5465 (UCCND-CSD-5) RANDOM WALKS WITH SPECIFIED FREQUENCIES OF OCCUPIED STATES. Wilson, D. G. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). Oct 1974. Contract W-7405-eng-26. 26p. Dep. NTIS $4.00.

The class of all one step random walks in which transitions with the same state are permitted and which have a specified long term frequency of occupied states is identified. A correspondence is established between the points of a certain polytope and the transition matrices for such random walks. Explicit formulae are given for a number of transition matrices with special characteristics and as a result necessary and sufficient conditions for there to be a classical one step random walk solution are obtained. Two procedures for generating transition matrices are proposed. Some comments are offered on selecting a good transition matrix from among the many acceptable ones. (auth)

5466 (UCCND-CSD-6) QR ALGORITHM AND HYMAN'S METHOD ON VECTOR COMPUTERS. Ward, R. C. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). Oct 1974. Contract W-7405-eng-26. 22p. Dep. NTIS $4.00.

The implementation on vector computers of the QR algorithm and of iterative schemes based on obtaining the determinant and its derivatives by Hyman's method are presented. It is shown that iterative schemes based on Hyman's method will probably be more efficient than the QR algorithm on vector computers for large matrices. A theoretical comparison of the Laguerre iterative scheme with the QR algorithm is presented using the latest available CDC STAR-100 instruction execution times. In addition, the results of several test cases run on the Laguerre-Hyman algorithm on a serial computer are reported. (auth)

5467 (UCRL-76137) A LOOK AT THE LLL OCTOPUS SYSTEM. Pehrson, D. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Oct 1974. 14p. (CONF-741001-23). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Most of the Lawrence Livermore Laboratory's (LLL) computation, data storage, and terminal communications capabilities are interconnected within the Octopus computer network. The network consists of superposed subnetworks, each performing one primary function. Interconnection between subnetworks permits some sharing of network channel resources and alternate routing of data. Each of the large worker computers in the network is a self-sufficient system, operated with an LLL-developed timesharing operating system. The network provides remote access for interactivity and file-based I/O, and a central 10^{12}-bit data base as an online alternative to conventional magnetic tape. (auth)

Miscellaneous

5468 (BNWL-SA-5087) TRANSPORT AND DEPOSITION OF POLLUTANTS DOWNWIND OF ST. LOUIS. Young, J. A.; Tanner, T. M.; Thomas, C. W.; Wogman, N. A.; Petersen, M. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. 6p. (CONF-740921-19). Dep. NTIS $4.00.

From atmosphere - surface exchange of particulate and gaseous pollutants symposium; Richlang, Washington, USA (4 Sep 1974).

The St. Louis metropolitan area generates large numbers of pollutant materials, some of them toxic, into the atmosphere. These contaminants are carried large distances by the prevailing winds and may affect regions considerably downwind of St. Louis. The concentrations of trace elements, sulfates, SO_2, CO, and Freons were measured in air samples collected upwind, in, and downwind of St. Louis during July of 1973 and 1974 to determine the atmospheric concentrations of these contaminants produced by St. Louis and to determine the rates at which the concentrations were decreased downwind by atmospheric mixing processes, dry deposition on the earth's surface, and in the case of SO_2, chemical reactions. Sampling and analytic methods are described. (CH)

5469 (BNWL-SA-5096) SURFACE DEPLETION MODEL FOR DEPOSITION FROM GAUSSIAN PLUME. Horst, T. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. 14p. (CONF-740921-7). Dep. NTIS $4.00.

From atmosphere - surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

When the atmospheric diffusion of a material is described by the usual Gaussian plume model, dry deposition of the contaminant onto the underlying surface is commonly accounted for by appropriately reducing the source strength, as originally proposed by Chamberlain. A more realistic model is developed that selectively depletes the Gaussian plume in the vicinity of the deposition surface rather than throughout the vertical extent of the plume as done in the source depletion model. The improved model is used to show that the source depletion model consistently overpredicts the surface air concentration and the deposition at downwind locations close to the source and, as a consequence, is biased in the opposite sense for locations far from the source. At all distances from the source, the source depletion model overestimates the total deposition between source and receptor and consequently underpredicts the amount of remaining airborne material. Quantitative comparisons are shown to aid the user in choosing, for his particular circumstances, between the less accurate source depletion model and the computationally more complex surface depletion model. (auth)

5470 (BNWL-SA-5097) RESULTS OF IN CLOUD TRACER RELEASES IN FRONTAL STORMS. Davis, W. E.; Young, J. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 28p. (CONF-741003-1). Dep. NTIS $4.50.

From precipitation scavenging conference; Champaign, Illinois, USA (13 Oct 1974).

Six frontal storms were injected with a variety of tracers. The examination to date of the tracers in rainwater has revealed that measurable concentrations occurred in many of the samples. Maximum tracer deposition has occurred 20 to 40 nautical miles downwind from the area where the vertical wind profile, coupled with fall velocities of Z to 5 m sec^{-1}, would indicate where initial ground deposition should have occurred. Some possible explanations are presented as well as a discussion of tracers used. (auth)

5471 (BNWL-SA-5125) PREDICTED DRY DEPOSITION VELOCITIES. Sehmel, G. A.; Hodgson, W. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1974. Contract AT(45-1)-1830. 35p. (CONF-740921-13). Dep. NTIS $4.75.

From atmosphere-surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

Particle deposition velocities are predicted from a steady-state one-dimensional mass transfer model. Dimensionless integral mass transfer resistances are used for the predictions. Predictions are made for a particle density of 1.5 g/cm^3 and a reference concentration height of 1 m. Ranges of variables considered are for individual particle diameters from 0.01 to 100 μm, roughness heights from 10^{-4} to 10 cm, friction velocities from 10 to 200 cm/sec, and Obukhov's stability length criteria of ±10 m. (auth)

5472 (BNWL-SA-5129) SOIL ERODIBILITY, SOIL EROSION, AND SECONDARY SUCCESSION FOLLOWING WILDFIRE IN A SHRUB-STEPPE. Hinds, W. T.; Sauer, R. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-1830. 27p. (CONF-740921-6). Dep. NTIS $4.50.

From atmosphere - surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

Ecological disturbances and the subsequent secondary succession are followed in a plant community regarding a range fire and for disruptions regarding erosive winds. Some insights concerning the effect on succession that a change in soil substrate can produce in the early stages of succession are discussed. Some relatively subtle differences in one factor of an ecosystem can lead to long-lasting effects in the plant communities affected. (MCW)

5473 (BNWL-SA-5135) MEASUREMENT OF PARTICULATE PLUME DEPLETION BY COMPARISON WITH INERT GAS PLUMES. Nickola, P. W.; Clark, G. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. 23p. (CONF-740921-8). Dep. NTIS $4.25.

From atmosphere - surface exchange of particulate and gaseous pollutants symposium; Richland, Washington, USA (4 Sep 1974).

The successes and shortcomings of the 1972–73 series of multi-tracer releases are reviewed. Tracers were dispersed to the atmosphere simultaneously from an elevation of 26 m. Although the particulate tracer, zinc sulfide, showed strong evidence of depletion in the near-ground layers, problems in calibration of the tracer assay technique complicate the specification of the magnitude of this depletion. Estimation of the zinc sulfide deposition was accomplished through comparison with the nondepositing, inert gas tracer, krypton-85. The krypton displayed strong evidence of "reflection" from the ground on one of the three experiments examined. The density of vertical samplers on the field measurement grid is currently not great enough to permit mass balance computation of high confidence. Following release into an unstable atmosphere, about 1% of the particulate zinc sulfide is estimated to have deposited before the plume reached 200 m. During one release into a stable atmosphere, 0 to 1% of the tracer deposited during movement to 812 m. During release into a somewhat less stable atmosphere, from 3 to 6% of the particulate zinc sulfide was deposited during traversal to 842 m. (auth)

5474 (ORNL-TM-4694) ARCHAEOLOGICAL SURVEY WITH EMPHASIS ON PREHISTORIC SITES OF THE OAK RIDGE RESERVATION, OAK RIDGE, TENNESSEE. Fielder, G. F. Jr. (Tennessee Univ., Knoxville (USA). Dept. of Anthropology). Oct 1974. Subcontract 3973. 130p. Dep. NTIS $9.50.

For Oak Ridge National Lab., TN.

The survey located and investigated 45 sites of aboriginal occupation and several early historic Euroamerican homestead sites. Most of the major archaeological periods in the eastern Tennessee chronological sequence were represented. One aboriginal site was assigned to the Paleo-Indian period; eight were assigned to the Archaic period; twenty-four contained Woodland period materials; and five sites were occupied during the Mississippian period. Sites were distributed along the drainage system of the Clinch River and others on the tributary streams of Poplar Creek, East Fork of Poplar Creek, and White Oak Creek. (MCW)

5475 (ORNL-tr-2864) ARSENIC EMISSION IN THE REGION OF NOVAKY. Jirele, V. Translated from Vod. Hospod., B; 21: No. 2, 23-30(1971). 15p. Dep. NTIS $4.00.

In 1966–1968, the external and internal dust pollution of the atmosphere was studied in the Nováky power plant, and analyses of fallout particulates and aerosols were made. The purpose of the study was to determine the compounds that are potentially dangerous for employees of the plant and for the general population in the vicinity. A solution was proposed for the problem of removal of the toxic substances before they enter the combustion facility of the plant. A system was proposed, and a model facility for removal of the toxic substances from the combustion products of the power plant was tested. Preliminary tests of SO_2 removal were performed. The tests showed that the facility operated with the expected results. (auth)

5476 (ORO-4045-11) GASEOUS ION CHEMISTRY: ANALYTICAL APPLICATIONS. Progress Report IV, May 1, 1973–August 31, 1974. Torrey, R. P. (Tennessee State Univ., Nashville (USA)). 1974. 21p. Dep. NTIS $4.25.

Experimental research on gaseous ion chemistry with analytical applications is summarized. High pressure electron impact studies of argon are described in which the performance of a quadrupole mass spectrometer equipped with a high pressure ion source was studied. (JFP)

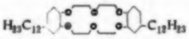
5477 (RISO-313) TABLES OF PRODUCTS OF TENSOR OPERATORS AND STEVENS OPERATORS. Lindgard, P. A. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jul 1974. 79p. Dep. NTIS (US Sales Only) $7.00.

Numerical tables of products of tensor (Racah) operators, $R_{l,m}(J)$, and Stevens operators, $O_l^m(J)$, working within a J-multiplet are given as a function of $X = J(J+1)$. Examples of the use of the tables, such as the calculation of commutation relations and thermal averages, are given. All values of l and m up to six are included. (auth)

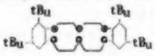
Chemistry

5478 (RT/CHI-(74)5) TWO NEW ALKYL SUBSTITUTED AROMATIC MACROCYCLIC POLYETHERS. Tusek, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Apr 1974. 25p. Dep. NTIS (US Sales Only) $4.25.

Two new crown compounds: the bis(4-hexadecyl benzo)-18-crown-6:



and the bis(3,5-di-tert-butyl benzo)-18-crown-6:



were synthesized. The proof of their structure and of their extractive behavior with regard to alkaline metals is given. (auth)

5479 (SAND-74-8231) EXPERIMENTAL INVESTIGATIONS OF LOCAL EMISSION MECHANISMS WITHIN PRESENT AND PROPOSED INTERNAL COMBUSTION ENGINES USING LASER RAMAN SPECTROSCOPY. Setchell, R. E. (Sandia Labs., Livermore, Calif. (USA)). Oct 1974. Contract AT(29-1)-789. 69p. Dep. NTIS $6.50.

Sandia Laboratories proposes a research program to experimentally investigate emission formation processes occurring locally within the combustion chamber of spark-ignition, internal combustion engines. The program is motivated by the fact that time-dependent, three-dimensional gradients in the temperature and composition of the combustion gases are highly important in determining the concentrations of emissions in the exhaust, yet accounting for these gradients in an analytical model of the combustion cycle is a very difficult task. The proposed experimental approach is based on a recently demonstrated capability of applying Raman spectroscopy to measure temperatures and emission concentrations at discrete points within flame gases. The application of Raman spectroscopy to combustion chamber measurements will proceed from an initial demonstration phase using a simple L-head engine, to a final application phase involving investigations in new engine designs, such as stratified-charge configurations. (auth)

5480 (UCID-16610) SAFETY IN HANDLING HAZARDOUS CHEMICALS. Randall, W. L. (comp.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1974. Contract W-7405-eng-48. 12p. Dep. NTIS $4.00.

Properties, safe means of handling, storage, and disposal are summarized for six acids: hydrochloric, hydrofluoric, nitric, sulfuric, phosphoric, and perchloric acids. Hydrochloric, hydrofluoric, and nitric acids build up some gas pressure in tightly capped containers at room temperature. Sulfuric, phosphoric, and perchloric acids do not build up gas pressure under normal supply and storage conditions. HNO_3 is a strong oxidizing agent as well as a strong acid. $HClO_4$ is a strong acid even when cold, and a strong oxidizing compound when heated. H_3PO_4, HCl, and HF do not form explosive compounds. (MCW)

Life Sciences

5481 (LA-UR-74-1476) UPTAKE KINETICS OF RELATIVELY INSOLUBLE PARTICLES BY TRACHEOBRONCHIAL LYMPH NODES. Thomas, R. G. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 25p. (CONF-740930-5). Dep. NTIS $4.25.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

Tracheobronchial lymph nodes accumulate a portion of material deposited in the deep lung following inhalation of relatively insoluble particles. Experiments involving a variety of compounds, inhaled singly or repeatedly, indicate that the kinetics of lymph node uptake are fairly independent of particle characteristics and mammalian species. The buildup per unit weight of nodal tissue, compared to lung tissue with time, may be represented by a linear logarithmic function. However, the scatter in experimental points may be large at any given time post-inhalation exposure, allowing for a number of different kinetic descriptions of uptake to be derived. The logarithmic pattern of accumulation may be approximated over an extended time range (several years) by use of a combination of first-order kinetics of loss from lung and buildup in lymph nodes, but it is recognized that the processes are much more complicated than this treatment would indicate. Clearance (loss) from the lymph nodes is not well defined, but this aspect has been discussed in light of the kinetic models presented. (auth)

5482 (UCB-34P-5-66) MECHANISM AND KINETICS OF MINERAL UPTAKE BY PLANTS. Annual Progress Report, October 1, 1973—September 30, 1974. Jacobson, L. (California Univ., Berkeley (USA). Dept. of Soils and Plant Nutrition). Jun 1974. Contract AT(04-3)-34. 21p. Dep. NTIS $4.25.

A comparison of K uptake by vetch and barley revealed significant differences. Uptake by excised vetch roots was highly pH sensitive and responded very strongly to the presence of Ca. The uptake of K was increased threefold at pH 5 but decreased by 20% at pH 9 in the presence of Ca. The uptake behavior of barley roots was qualitatively similar to that of vetch, showing however a limited pH sensitivity and a weaker response to Ca. (auth)

Materials

5483 (AE-495) ESTIMATION OF THE RATE OF SENSITIZATION IN NICKEL BASE ALLOYS. Wiberg, J. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

An attempt was made to estimate the time for formation of a chromium depleted zone (<13 a/o Cr) of width 200 Å around grain boundaries in Inconel 600 and Incoloy 800. The calculations follow a theoretical model derived for sensitization of austenitic stainless steels with basic composition 18% Cr, 7% Ni at temperatures above 325°C. To apply this theory considerable extrapolations regarding Ni-content and temperature are necessary. Bearing in mind these extrapolations and some other assumptions, the calculations show that sensitization time at 325°C is of the order of 1,000 years for Incoloy 800 and 10 years for Incoloy 600. The uncertainty of these values is such, that the only possible statement about Incoloy 800 is that the risk of sensitization as defined above is small. (auth)

5484 (AED-CONF-74-261-004) BEST ENERGY FOR PRODUCTION OF ELECTRON-CHANNELING-PATTERN IN SEM WITH BACKSCATTERED ELECTRONS. Kuhnle, G.; Seiler, H. (Tuebingen Univ. (F.R. Germany). Inst. fuer Angewandte Physik). 1974. 9p. (In German). INIS.

From DECHEMA annual meeting; Frankfurt am Main, F.R. Germany (4 Jun 1974).

6 figs.; 4 refs. With abstract in German and English.

The anisotropy of the electron backscattering coefficient of single crystal surfaces increases with decreasing energy of the primaries. Due to amorphous layers on the single crystals the best contrast K of the electron-channeling-pattern in SEM does not appear at low primary energies. A simple expression for K depending on the energy of the primaries and the thickness of the amorphous layers is suggested and compared with experimental results. For Si (111) and primaries of 20 keV, K is reduced by an amorphous Si layer of 220 AE to e^{-1} K. (auth)

5485 (AERE-R-7798) YIELD AND FRACTURE OF SOME GLASS SPHERE FILLED NYLONS. Scott, J. M.; Phillips, D. C. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Sep 1974. 27p. Dep. NTIS (US Sales Only) $4.50. UK 50 pence.

The influence of glass sphere and fiber fillers on the fracture behavior of nylon is evaluated. The moulding of test specimens is described. Results of tensile and fracture energy measurements on these specimens and on a commercially supplied set show modest improvements in stiffness with slight decrease in tensile strength compared with unfilled materials. The glass sphere filled materials showed, however, a lower fracture energy. The evaluation includes the influence of water absorption. (auth)

5486 (BDX-613-1105(Rev.)) ALUMINUM ETCHANT STUDIES. Knopf, W. H. (Bendix Corp., Kansas City, Mo. (USA)). Sep 1974. Contract AT(29-1)-613. 15p. Dep. NTIS $4.00.

More than 80 chemical solutions were evaluated for etching precision patterns in 0.00045-inch-thick (11.43 μm) type 1145 rolled aluminum. The primary purpose of this etchant evaluation is to improve the smoothness of the pattern edge. Improving edge smoothness will increase element width measurement accuracy from ±0.0003 inch (7.62 μm) to ±0.000025 inch (0.635 μm). (auth)

5487 (BDX-613-1140(Rev.)) RIGID URETHANE FOAM BASED ON METHYL-ALPHA-(D)-GLUCOSIDE AND E-CAPRO-

LACTONE. McFarland, J. W. (Bendix Corp., Kansas City, Mo. (USA)). Nov 1974. Contract AT(29-1)-613. 36p. Dep. NTIS $4.00.

A study was made of resins based on methyl-alpha-(D)-glucoside. Foams prepared using this resin and a prepolymer based on polymethylene polyphenyl isocyanate had excellent high temperature strength when tested at 400°F (204.4°C). Best results were obtained with methyl glucoside purchased as a 65-percent water solution containing 30 percent beta-methyl-glucoside. (auth)

5488 (COO-2408-1) PRESSURE SINTERING AND CREEP DEFORMATION: A JOINT MODELING APPROACH. Progress Report, January 1, 1974–December 31, 1974. Notis, M. R. (Lehigh Univ., Bethlehem, Pa. (USA)). 1974. Contract AT(11-1)-2408. 14p. Dep. NTIS $4.00.

Studies were initiated to compare the densification during later stages of pressure sintering and the creep deformation behavior for two oxide materials, CoO and $MgAl_2O_4$, as a function of stress, temperature, grain size and porosity. Hot pressed specimens have been fabricated, densification kinetics have been observed and creep specimens were made. A high temperature dead-load creep facility has been constructed and is now operational. Studies of the densification kinetics during final stage pressure sintering of $MgAl_2O_4$ were interpreted in terms of both phenomenological and atomistic constitutive equations. Densification kinetics indicate non-viscous deformation mechanisms to be operative and the rate controlling process appears to be extrinsic oxygen-lattice diffusion. Three new and unique deformation (densification)-mechanism maps were developed in order to demonstrate deformation effects. A map in log grain size-temperature space was used to illustrate the effects of microstructure and temperature at constant stress. A map in log stress–log grain size space was developed to demonstrate stress and grain size effects on densification behavior at constant temperature. Finally, maps were generated in log stress-temperature space that display contours of constant stress exponent across dominant mechanism fields. These maps provide the background necessary for the generation of quantitative three-dimensional deformation maps. (auth)

5489 (LA-UR-74-842) IODIZED STARCH GRANULES AS A CAUSE OF STARCH PERITONITIS. Goodrich, E. O. Jr.; Prine, J. R.; Wilson, J. S. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 4p. (CONF-741027-1). Dep. NTIS $4.00.

From meeting of the surgical forum; Miami Beach, Florida, USA (21 Oct 1974).

There is a serosal adhesogenic effect of powdered starch glove lubricant that is severely aggravated by contact with iodophor preparations or detergents. Therefore, it seems prudent to remove excess iodophor skin preparation material from the skin, as well as excess starch from the gloves, prior to performing a laparotomy or thoracotomy. (auth)

5490 (MHSMP-74-9A) EXTRUDABLE EXPLOSIVES: COMPOSITIONAL ANALYSIS, COMPATIBILITY, CRYSTAL GROWTH AND SILICONE OIL MIGRATION STUDY. Period Covered: January–March 1974. Faubion, B. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 10p. Dep. NTIS $4.00.

Differential Pulsed Polarography was evaluated as a technique for quality control analysis of the RDX/Sylgard composition. An error analysis of the technique is given. Several batches of RDX/Sylgard were analyzed and are in agreement with results obtained by solvent extraction. Thermal aging of the Coupon test samples is continuing. Zeiss analysis has been completed on the first two sample sets in the RDX crystal growth study. So far no trends were observed. A technique for determination of RDX crystal growth in the cured RDX/Sylgard is also being investigated. This technique will hopefully be used to determine if crystal growth has occurred in the RDX/Sylgard removed from the Coupon test assemblies. A method for the detection of trace amounts of silicone oil on the surface of a pressed pellet of RDX is being developed utilizing Laser Raman spectrophotometry. At present the method is capable of detecting as little as 0.5 μl of DC 200 silicone oil absorbed on a one-gram pellet of RDX. The method will be used to determine if any of the uncured oils in the Sylgard migrate out of the RDX/Sylgard and through the RDX pellet with which the RDX/Sylgard is in contact in the Coupon Test assemblies. (auth)

5491 (MHSMP-74-9B) PETN RECRYSTALLIZATION STUDY. Period Covered: January–March 1974. Foster, P. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 19p. Dep. NTIS $4.00.

Pentaerythritol tetranitrate (PETN) was crash recrystallized while controlling the temperature of the acetone, temperature of the water, amount of water, drying temperature, and impurities. Particle size data on the recrystallized PETN were collected and analyzed using factorial analysis and stepwise regression to determine which variables have the greatest effect on particle characteristics. (auth)

5492 (MHSMP-74-9C) FORMULATION AND PROCESSING OF PBX. Period Covered: January–March 1974. Osborn, A. G.; Stallings, T. L.; Quinlin, W. T. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 4p. Dep. NTIS $4.00.

Approximately 816 kg of the HMX/Estane PBX were made to supply material for more thoroughly investigating skid test sensitivity and pressing parameters. (auth)

5493 (MHSMP-74-9D) ENRICHMENT OF RDX. Period Covered: January–March 1974. Sandoval, J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 5p. Dep. NTIS $4.00.

Large-scale isolation of high purity RDX, (1-3-5-trinitro-1,3,5-triazacyclohexane), can be promoted through repeated recrystallizations from acetone of an RDX-HMX composition.

5494 (MHSMP-74-9E) PETN/LX-13 PROCESSING. Period Covered: January–March 1974. Stallings, T. L.; Locke, J. G.; Osborn, A. G.; Duncan, A. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 10p. Dep. NTIS $4.00.

The new continuous PETN precipitator was received and was temporarily installed in the HE formulation area for operational checkout; three preliminary runs were made. (auth)

5495 (MHSMP-74-9F) DETERMINATION OF DEGREE OF CURE OF ISOTHERMALLY AGED RDX/SYLGARD. Period Covered: January–March 1974. Clink, G. L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 32p. Dep. NTIS $4.75.

An isothermal aging study of uncured RDX/Sylgard (80/20 and 85/15 percent by weight) was undertaken to determine the chemical and physical cure of these materials as a function of temperature. (auth)

5496 (MHSMP-74-9G) RDX/SYLGARD. Period Covered: January–March 1974. Slape, R. J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 14p. Dep. NTIS $4.00.

An additional 50-pound batch of RDX was purified along with further efforts at recrystallization via the continuous precipitation process in order to optimize yield and improve reproducibility. Work on four 85/15 RDX/Sylgard batches continued, including RDX particle characterization after formulation, the measurement of detonation pressure via the aquarium test, the start of a study to determine the effects of aging on detonation velocity, and impact sensitivity tests to determine the suitability of the present test on extrudable-type explosives as well as to characterize the 85/15 RDX/Sylgard formulation. (auth)

5497 (MHSMP-74-9H) PASTE EXPLOSIVES: LIQUID CARRIER EVALUATION. Period Covered: January–March 1974. Faubion, B. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 7p. Dep. NTIS $4.00.

A microscope cold stage was constructed for studying the crystallization and solid liquid phase diagrams of liquid carriers proposed for PEX systems. The cold stage can be operated over the temperature range of +300 to -195 C. The melting points of EDNP, FEFO, and DFF were confirmed using this cold stage in conjunction with a polarizing microscope. (auth)

5498 (MHSMP-74-9I) SLOW PBX AND PLANE WAVE LENS DEVELOPMENT. Period Covered: January–March 1974. Crutchmer, J. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 12p. Dep. NTIS $4.00.

Nineteen billets of Comp. B-3 and baratol were pressed from previously formulated materials for plane wave lenses. Two 20.32 cm (8-inch) diameter plane wave lenses, P/081 Mod 1-D, Units 3 and 4, using Comp. B-3 as the fast component and 76/24 BN/TNT baratol as the slow component, were fired and analyzed. Two 20.32 cm P/081 Mod 11-A, and three each 10.16 cm (4-inch) diameter P/040 Mod 111-C and Mod 111-D plane wave lenses were fired and analyzed. These lenses used PBX 9404 as the fast component and 85/15 BN/TNT baratol as the slow component. (auth)

5499 (MHSMP-74-9J) HE PRESSING. Period Covered: January–March 1974. Harrell, J. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 4p. Dep. NTIS $4.00.

PBX 9404 was shown to have an increased tensile strength when compacted at process conditions of 85 C and 105 MPa, as opposed to the former 65 C and 140 MPa. The tensile strength of samples from large billets is even higher than that of the small test parts that were used to develop the process. (auth)

5500 (MHSMP-74-9K) X-RAY DIFFRACTION. Period Covered: January–March 1974. Blair, C. C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 6p. Dep. NTIS $4.00.

X-ray diffraction data were obtained for HNAB III at ambient temperature using the goniometer. This information agrees reasonably well with the x-ray data obtained earlier by using the Debye Scherrer powder camera. (auth)

5501 (MHSMP-74-9L) SENSITIVITY AND PERFORMANCE TESTING OF EXPLOSIVES. Period Covered: January–March 1974. Kramer, P. E. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 8p. Dep. NTIS $4.00.

There were two unsuccessful attempts to measure shock and free surface velocities on full scale wedge tests by use of the Detonation Electric Effect (DEE). Evaluation of a DEE/Aquarium method for measurement of C–J pressure continued. Wedge testing of paste explosives (PEX) was delayed by compatibility questions. One shot was finally fired, but only sketchy results are available at this time. Techniques and fixtures were developed for the simultaneous measurements of detonation velocity and critical thickness of very sensitivite, sprayable formulations. Several problems occurred with the drop hammer (impact sensitivity). (auth)

5502 (MHSMP-74-9N) DETERMINATION OF OCCLUDED CYCLOHEXANONE IN CRYSTALLINE RDX. Period Covered: January–March 1974. Sandoval, J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 9p. Dep. NTIS $4.00.

A gas chromatographic method for the quantitation of absorbed cyclohexanone in RDX, (1,3,5-trinitro-1,3,5-triazacyclohexane) recrystallized from this solvent, is described. (auth)

5503 (MHSMP-74-9P) PARTICLE CHARACTERIZATION. Period Covered: January–March 1974. Duncan, A. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 8p. Dep. NTIS $4.00.

Milling studies were continued on LX-13 and XTX-8003 formulations where particle characterization is performed following various mill passes under different milling conditions. Primary emphasis was on varying roller speed and roll pressure. Particle characteristics for five batches of LX-13 measured at various mill passes are given. (auth)

5504 (MHSMP–74-10A) THERMAL PROPERTIES, REACTIVITY AND COMPATIBILITY. Period Covered: January–March 1974. Myers, L. C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 18p. Dep. NTIS $4.00.

For California Univ., Livermore.

Some of the compounds eluded from the chemical reactivity test on PETN were identified as carbonyl sulfide and carbon disulfide and two others have been tentatively identified as cyanogen and hydrogen cyanide by GC/MS analysis. Repeated chemical reactivity test runs were made on samples of PETN from Mound Laboratory (K1202), DuPont, and a DuPont lot of Pantex purified material. Each of the three samples were observed to have a completely different thermal decomposition rate. Some high resolution mass measurements were made on m/e 85 and 86 observed when PETN was sublimed through a hot bed of stainless steel balls into the mass spectrometer. The measurements suggested an atomic combination of $C_4H_5O_2$ and $C_4H_6O_2$. The heat of fusion for 7 lots of LX-13 grade PETN and Mound Laboratory's Lot K1202 are reported. A comparison of the heats of fusion for a 20-month period for the PETN control sample are all within experimental error. Chemical reactivity test data for Adiprene L-315 using DABCO for the catalyst and for three other adhesives are reported. (auth)

5505 (MHSMP-74-10B) MECHANICAL PROPERTIES OF HIGH EXPLOSIVES. Period Covered: January–March 1974. Johnson, H. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 9p. Dep. NTIS $4.00.

For California Univ., Livermore.

Two RX-04-EE billets (nominal size was 16 kg having dimensions of 30 cm diameter × 14 cm high) were made using the standard pressing cycle for this material. Each billet was sectioned into halves and thermally treated. Results are given. (MCW)

5506 (MHSMP-74-10C) EXPLOSIVES PERFORMANCE. Period Covered: January–March 1974. Kramer, P. E. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 5p. Dep. NTIS $4.00.

For California Univ., Livermore.

The two cylinder shots on LX-10-0 were analyzed. The results were in fairly good agreement with LLL values, but were also similar to Pantex PBX 9404 results. The high density (1.871 g/cm^3) LX-10-1 cylinder shot was analyzed and indicated higher energy output than normal density (1.864 g/cm^3) LX-10-0. Three C-J pressure shots using RX-04-EE were fired using the magnesium plate technique. Problems were encountered and at least one more shot will probably be required. (auth)

5507 (MHSMP-74-20-A) ANALYSIS OF THE PRECIPITATE IN THE ADIPRENE L-315 CURING MIXTURE; NEW L-315 CATALYST WHICH REDUCES CURE TIME. Period Covered: April–June 1974. Foster, P. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. 14p. Dep. NTIS $4.00.

Several process problems were encountered with the Adiprene L-315 adhesive that is cured with 1,4 butanediol, trimethylolpropane, and ferric acetylacetonate. The major problem involves a precipitate formed during cure that apparently causes a long cure time. Analysis of the precipitate revealed that it is predominately the cure catalyst, ferric acetylacetonate, which may explain longer cure times when the precipitate is formed. Several new catalysts were evaluated in an effort to reduce cure time from the 18 to 20 hours experienced with ferric acetylacetonate. One of these catalysts, DABCO, is a promising substitute for ferric acetylacetonate. DABCO reduced ambient temperature cure time of the L-315 system to 6.5 hours based on a Shore A hardness of 60 and a shear strength above 28.25 N·m after 6.5 hours. (auth)

5508 (MHSMP-74-20-B) PETN/LX-13 PROCESSING. Period Covered: April–June 1974. Duncan, A. A.; Osborn, A. G.; Stallings, T. L.; Locke, J. G. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. 5p. Dep. NTIS $4.00.

Extrudability tests were run on the three Extex batches made last quarter from PETN precipitated in Production's continuous Bench Scale reactor. Preliminary results indicate that this reactor is suitable for producing Extex/LX-13 grade PETN. (auth)

5509 (MHSMP-74-20-E) EXTRUDABLE EXPLOSIVES: COMPATIBILITY, COEFFICIENT OF THERMAL EXPANSION, AND SILICONE OIL MIGRATION STUDY, APRIL–JUNE 1974. Faubion, B. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487-(A). 6p. Dep. NTIS $4.00.

No indication of incompatibility was observed in the three-month coupon test samples. Thermal aging is continuing and additional samples will be examined after six, nine and twelve months. Trace amounts of silicone oil were observed on the surface of the RDX pellet that was in contact with the RDX/Sylgard in the coupon assembly. The linear coefficient of thermal expansion of RDX/Sylgard was measured over the temperature range 250 to 350°K and has an average value of $(99 \pm 11) \times 10^{-6}$ K^{-1}. (auth)

5510 (UCID-16086) MICROSTRUCTURE OF CELLULAR SILICONE AS SHOWN BY THE SCANNING ELECTRON MICROSCOPE. Hammon, H. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Jul 1972. Contract W-7405-eng-48. 23p. Dep. NTIS $4.25.

Cellular silicone is made from a poly (methyl, phenyl) siloxane, containing a small proportion of vinyl groups. The cellular structure is obtained by incorporating urea prills (tiny spheroids) as a temporary filler. Crosslinking is accomplished by adding a peroxide and molding to shape under heat and pressure. The temporary filler is washed out and the material is given a post cure. Specimens of cellular silicone, Y-3260 and Y-3333, were examined at magnifications of 20X to 2000X by a scanning electron microscope. The spherical cell structure due to leaching of the temporary filler is readily apparent. Other voids due to broken urea particles are seen and an irregular porosity is evident that interconnects cells and accounts for the measured open cell content. (MCW)

5511 (UCID-16424) PARTICIPATION OF LLL IN JSEXP. Part A. Performance of Non-ideal HE. Part B. Characterization of ECX for Conventional Munitions. Finger, M.; Scribner, K.; Hornig, H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Dec 1973. Contract W-7405-eng-48. 26p. Dep. NTIS $4.50.

A significant improvement in the performance of shaped charges loaded with RX-08-BA over charges loaded with either RDX or Composition B at 6 cone diameter standoffs was shown. Further test firings will show if this improvement continues at longer standoffs. Additional diagnostics to be used in these tests (such as flash x-rays, high speed cameras, and foil switches) are designed to study the variables that influence performance. (auth)

Physics and Engineering

5512 (AEEW-M-1278) AIR FILTRATION WITH SPECIAL REFERENCE TO THE USE OF HIGH EFFICIENCY FILTERS. Dickson, J. L. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Nov 1973. 31p. Dep. NTIS (US Sales Only) $4.50.

Filter performance and economics are discussed for high efficiency air filtration. In summary, it is concluded that: the particle size distribution and concentration of the dust to be handled must be known; the efficiency and dust collecting characteristics of all the possible filtration methods as a function of particle size should be determined; it is not known whether an economic gain will be forthcoming in reducing the standard of filtration efficiency called for or in providing pre-filters; when high efficiency filters are used it is essential to realize their susceptibility to damage by mechanical means or by fire; and the design of housings must receive detailed attention to ensure that the sealing of the filters into the system is adequate and that maintenance, changing, and testing of the filters can be properly done. (MCW)

5513 (AERE-M-2654) CORRECTIONS OF ULTRASONIC (TIME DELAY) MEASUREMENTS OF CRACK DEPTH. Silk, M. G.; Lidington, B. H. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Sep 1974. 13p. Dep. NTIS (US Sales Only) $4.00. UK 50 pence.

An approximate correction procedure is derived and tested for application to ultrasonic crack depth measurements using a time delay approach. The correction is simple enough to be capable of application on line in appropriate circumstances. (auth)

5514 (AERE-R-7817) MATHEMATICAL MODELLING OF RADIANT HEAT TRANSFER IN FURNACES. Truelove, J. S. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Sep 1974. 40p. Dep. NTIS (US Sales Only) $5.00.

The zone model was used to predict temperature and heat flux distributions in a number of cylindrical furnaces. Initial conditions for the model were taken from experimental measurements, where available, or from a mathematical model of the gas flow field. Exchange factors defining direct radiant interchange between zones were evaluated by a combination of analytic and numerical integrations, without recourse to tabulated values, and corrected to allow for spatial variation in species concentration within the furnace. The radiative properties of the furnace gas were incorporated into the model using a mixed-grey-gas formulation. The predicted and measured distributions were found to be in good agreement. (auth)

5515 (BDX-613-879(Rev.)) TRANSDUCER FOR GAGING PRESSURE-SENSITIVE PARTS. Final Report. Eby, W. G. (Bendix Corp., Kansas City, Mo. (USA)). Nov 1974. Contract AT(29-1)-613. 46p. Dep. NTIS $5.50.

A low-contact-force, linear, variable-displacement transformer was developed. This air-actuated transducer is wholly pneumatic and is capable of developing a contact force ranging from 0.7 to 1.5 grams regardless of its attitude. Because the outside diameter of the case is 0.5 inch (12.7 mm), the unit is readily adaptable to existing fixtures. (auth)

5516 (BDX-613-967(Rev.)) HOLOGRAPHIC INTERFEROMETRY. Final Report. Schoeppner, M. P.; Watterson, C. E.; Collins, M. C. (Bendix Corp., Kansas City, Mo. (USA)). Nov 1974. Contract AT(29-1)-613. 63p. Dep. NTIS $5.45.

A capability for performing nondestructive holographic tests on various products and materials was developed. The principles, laboratory implementation, and use of holographic interferometry in detecting internal defects and strain anomalies in composite structures are described. (auth)

5517 (BDX-613-1193(Rev.)) PROCESSING OF MINIATURE INTERCONNECTIONS. Hollar, D. L. (Bendix Corp., Kansas City, Mo. (USA)). Nov 1974. Contract AT(29-1)-613. 16p. Dep. NTIS $4.00.

Miniature connection methods were developed and tested to minimize development hardware lead times and cost on small special design assemblies. Connector housings were molded using epoxy resin and room-temperature-vulcanizing (RTV) molds, and connector contacts were procured from commercial vendors. Three connector types were evaluated, including a small 21-pin rack-and-panel connector, a 10-contact strip connector, and a high-voltage flex-circuit connector. The feasibility of fabricating these connectors using the proposed methods was proved, and several prototype units were fabricated and tested with favorable results. (auth)

5518 (BMFT-FB-T-73-05) DEVELOPMENT OF METHODS FOR THE INTENDED ADJUSTMENT OF THE CARRIER LIFETIME IN SILICON DISCS. Lambert, J. L.; Sommer, K. H.; Borchert, E.; Koch, J. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany); Zentralstelle fuer Luft- und Raumfahrtdokumentation und -Information, Muenchen (F. R. Germany)). Apr 1973. 194p. (In German).

The control of the carrier lifetime in n-type base regions of gallium diffused power thyristor and diode structures is discussed. The scattering of the lifetime values after lowering the lifetime by gold diffusion is due to different vacancy generation rates in different silicon crystals. A practical example of gold diffusion technology is discussed. The phosphorus gettering mechanism is studied. High lifetimes can also be obtained by liquid phase diffusion from gallium. Hall effect measurements indicate the concentrations of deep impurities before and after the high temperature processes. A new method of lifetime measurement developed for process control is described. (GE)

5519 (BNL-19211) PHOTODEFORMATION MEASUREMENTS OF REFUSE PILE STRUCTURE MOVEMENTS. Powell, J. R.; Reich, M.; Steinberg, M.; Kopp, J. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 21p. (CONF-741025-2). Dep. NTIS $4.25.

From conference on coal and the environment; Louisville, Kentucky, USA (22 Oct 1974).

Measurements of deformation of mine structure such as the roof, ribs, floor of mine tunnels, above ground refuse piles, and tailing dams are safety measurements that are necessary. New accurate methods were developed in high-energy physics to automatically measure the 3-dimensional spatial coordinates of particle tracks in bubble and spark chambers. The application of the method in the mining industry for mechanical structure movements is described. The development of the automatic scanner, the Hough-Powell Device, enhanced the processing of the data and its application is described. The theory of the measurement is presented in detail. Field measurement tests in White Pine Copper Mine, White Pine, Michigan, are described. (MCW)

5520 (CONF-740715-15) PHOTOIONIZATION. Berkowitz, J. (Argonne National Lab., Ill. (USA)). 1974. 39p. Dep. NTIS $5.00.

From 5th international radiation research congress meeting; Seattle, Washington, USA (14 Jul 1974).

The first order interaction of electromagnetic radiation with gaseous matter is photoabsorption. When photoabsorption occurs at photon energies larger than the ionization threshold, a large fraction (though not all) of the photoabsorption leads to ionization for molecular systems. The intensive study of this photoionization process during the past ~15 years by photoionization mass spectrometry and photoelectron spectroscopy has revealed the existence of numerous processes which would be obscured if one were measuring total ionization cross sections. Photoelectron spectroscopy provides one with a clear picture of the orbital structure of electrons in molecules, and in addition shows one how ionization proceeds by removing single electrons (primarily) from successive orbitals. The ions formed can thereby be left in various states of excitation. An active study at the present time is the measurement of the partial cross sections for formation of these various states, and their dependence on photon energy. Photoionization mass spectrometry provides some clues about the subsequent life history of these ionic states — their relative probability of survival or decomposition into fragments. The various mechanisms of autoionization (electronic, vibrational, rotational) are examined, and examples are chosen to illustrate this behavior. The occurrence of Auger processes following inner shell ionization is discussed, as is the consequence of the Auger shower on mass spectra. The integrated photoabsorption and photoionization cross section across the entire electromagnetic spectrum is then compared with various sum rules. (auth)

5521 (COO-1105-103) NONRADIATION-INDUCED THERMOLUMINESCENCE. Rhyner, C. R.; Cameron, J. R. (Wisconsin Univ., Madison (USA). Dept. of Physics). [nd]. Contract AT(11-1)-1105. 6p. Dep. NTIS $4.00.

The nonradiation-induced thermoluminescence of LiF powder was studied. Two different types of powder were studied: one was relatively pure optical grade scrap (H63A), and the second material was TLD-100 LiF. The methods of producing the various peaks of the glow curve or combinations of the peaks were studied. The observed peaks were classified as R (radiation-induced), T (Tribo- or mechanically-induced), S (shaking or perhaps charge-induced), and D (duration-induced, perhaps caused by absorbed gases). The principal difficulty was the nonreproducibility of the magnitudes of all but the R peak. (auth)

5522 (COO-2130-134) DECAY OF THE 2^3S_1 STATE IN HELIUMLIKE SULFUR AND CHLORINE. Cocke, C. L.; Bednar, J. A.; Curnutte, B.; Randall, R. (Kansas State Univ., Manhattan (USA)). 1974. 4p. (CONF-740711-6). Dep. NTIS $4.00.

From 4th international conference on atomic physics; Heidelberg, F. R. Germany (22 Jul 1974).

Time-of-flight techniques were used to measure the lifetime of the 2^3S_1 state in heliumlike sulfur and to improve on an earlier measurement in chlorine. The results show consistency with theoretical predictions, although some experimental questions persist. (JFP)

5523 (COO-3158-33) DETECTION OF THE PERIODIC STRUCTURE OF HIGH ANGLE TWIST BOUNDARIES. II. High Resolution Electron Microscopy Study. Report No. 2294. Tan, T. Y.; Sass, S. L.; Balluffi, R. W. (Cornell Univ., Ithaca, N. Y. (USA)). Aug 1974. Contract AT(11-1)-3158. 25p. Dep. NTIS $4.25.

High resolution electron microscopy was used to image directly the 0-lattice of ⟨001⟩ twist boundaries with misorientations up to 25° and 0-lattice spacings as small as 7 Å. The results were entirely consistent with the conclusions reached on the basis of the diffraction experiments that are described. An experimental method was devised for determining whether the 0-lattice was imaged by conventional diffraction strain contrast or by interference strain contrast which arises from interference between fcc and 0-reflections resulting from the periodic structure of the boundary. It was demonstrated that spacings down to about 34 Å were imaged mainly by means of diffraction strain contrast, while networks with spacings of about 16 Å or less were imaged mainly by means of interference strain contrast. Efforts were also made to detect secondary grain boundary dislocation networks and such networks were observed in the vicinity of $\Sigma = 5$, 13, and 17 boundaries over a larger range of misorientations than detected previously. (auth)

5524 (COO-3551-14) D-STATE RESONANT EFFECTS ON THE TRANSPORT PROPERTIES OF LIQUID Ni, Pd, AND Pt. Brown, J. S.; Lopez-Escobar, A.; Todd, J. R. (Vermont Univ., Burlington (USA)). 1973. 7p. Dep. NTIS $4.00.

A description is given of calculations of muffin-tin potentials for the metals Pd, Pt, and Ni, employing various approximations appropriate to the solid and liquid phases. Calculations of the electrical resistivity and thermopower coefficients of these metals are discussed, using a theoretical development. The model incorporates d-state resonant effects into the d-wave phase shifts of conduction electrons scattered in the liquid metal from the muffin-tin cores. The use of various approximations such as charge renormalization and the treatment of the Lowdin α-expansion for a radial distribution of liquid neighbor cores in the metal is discussed, along with a preliminary treatment of the screening interaction. In addition the problems concerned with the extension of the present ideas to the treatment of electrical resistivity of PdH_n and PdD_n are briefly discussed, with much of the impetus drawn from recent photoemission studies and APW calculations of PdH_n. Finally the testing of an alternative theory of resistivity due to Rousseau, Stoddart & March (1972), based on Edwards' (1965) approach to inverse transport coefficients is discussed, and in addition the possibility of the testing of the coherent-wave approximation of Evans et al. is discussed. This latter approximation, which requires an angular-momentum decomposition of the density of states, shows signs of building in the two-band s-d effects which Mott (1971) has argued are a necessary component of any realistic treatment of transition metal resistivity. Finally the relation of the results to those given by Animalu's (1973) recent extension of the HA-model potential to treat transition metals is discussed. (auth)

5525 (EGG-1183-1600) CALIBRATION OF CURVED CONVEX CRYSTAL SPECTROGRAPHS. Singman, L. (EG and G, Inc., Las Vegas, Nev. (USA)). 24 Jul 1973. Contract AT(29-1)-1183. 28p. Dep. NTIS $4.50.

The ratio of the power per unit length of an x-ray beam reflected from the convex side of a curved LiF crystal to the intensity of the beam incident on the crystal were measured for a range of photon energies, 5 to 40 keV. Calculated ratios were derived and are in approximate agreement with the measured. (auth)

5526 (ITF-74-79P) ELECTRON STATISTICS IN A ZERO-GAP SEMICONDUCTOR. Tal'yanskii, I. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

Some problems of the electron statistics in the semiconductor with zero energy gap are considered. In this extremely nonparabolic case the energy is a linear function of quasi-momentum, and as a consequence of it, there arise essential differences from the formulas of electron statistics in the standard (parabolic) bands. The expressions for states density and electron concentration without fields and at quantizing magnetic field are obtained. The degeneracy conditions of the electron gas are investigated, and the comparison with a parabolic bands case is carried out. The effect of strong nonparabolicity on the effective mass and on the Shubnikov-de Haas oscillations are considered. The equations for chemical potential calculation are given. The expression for Hall coefficient in any (non-quantizing) magnetic field is obtained. (tr-auth)

5527 (ITF-74-93P) COLLECTIVE VARIABLES IN THE GRAND CANONICAL ENSEMBLE. Yukhnovskii, I. R.; Gonopol'skii, O. L. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 21p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The method of collective variables for the systems with the varied number of charged particles is generalized. The partition function and ρ-particle distribution functions of the grand canonical ensemble determined by the introduction of ρ-particle transition function to the collective variables are under consideration. Expressions for the one-particle and two-particle distribution functions up to the first cluster coefficient and for the partition function up to the second cluster coefficient are obtained. (tr-auth)

5528 (KAPL-P-4018) THOUGHTS ON PERFORMING ENGINEERING ANALYSIS WITH THE COMPUTER. Fischer, W. W. (Knolls Atomic Power Lab., Schenectady, N. Y. (USA)). [nd]. Contract W-31-109-eng-52. 6p. Dep. NTIS $4.00.

The desirable characteristics of a computer-based engineering analysis system are discussed. The discussion includes capabilities, philosophy guiding system development, documentation, applications, use of data generation, and interpretation of results. Brief comments are offered based on experience in the areas of documentation, coding, costs, and control. It is concluded that the existing process is in quite widespread use, is well founded, is very useful, will experience even greater application in the near future, and presents challenges both in controlling application accuracy and in managing initiative and creativeness in application. (auth)

5529 (KFKI-74-64) MULTIPHOTON ELECTRON EMISSION PROCESSES INDUCED BY DIFFERENT KINDS OF ULTRASHORT LASER PULSES. Farkas, G.; Horvath, Z. G. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

Using ultrashort laser pulses of regular (Gauss-shaped) time and spectral distribution, theoretically predicted multiphoton electron emission processes have been observed. On changing this regular form of the ultrashort light pulses, however, the character of the emission process also changes, the explanation of which follows only partly from the evolution of the mode— locking train. (auth)

5530 (KFKI-74-66) VARIABLE GAS-FLOW COOLING SYSTEM FOR TEMPERATURES BETWEEN 4.2 AND 400°K. Balla, J. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Sep 1974. 14p. Dep. NTIS (US Sales Only) $4.00.

Different types of gas-flow temperature control devices are briefly reviewed. (WHK)

5531 (ORNL-NSF-EP-30) OPERATIONAL, MAINTENANCE, AND ENVIRONMENTAL PROBLEMS ASSOCIATED WITH A FOSSIL FUEL-FIRED POTASSIUM-STEAM BINARY VAPOR CYCLE. Fraas, A. P. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 60p. Dep. NTIS $6.00.

Design studies indicate that superimposing a potassium vapor topping cycle on a conventional steam cycle should increase the thermal efficiency of a fossil fuel-fired plant to over 50%, thus reducing the fuel consumption by about 25% and the rejection of waste heat to the environment by about 50%, both highly desirable objectives. The reactive character of potassium, however, raises serious safety questions. A review of the special operational, maintenance, and environmental problems posed by a fossil fuel-fired potassium vapor cycle plant indicates that such a system would present unusual and difficult problems, but, if the system is properly designed, these appear manageable. Examination of possible failure modes indicates that leaks should be inherently slow to develop, and relatively simple, reliable instrumentation techniques of adequate sensitivity are available to detect them at an early stage. The attendant operational and maintenance problems appear to be tractable. Under routine operating conditions, the gaseous and thermal emissions to the environment should be very low. The worst accident from the standpoint of the public would be the release of a substantial fraction of the potassium inventory to the stack. Such an accident is highly unlikely because the combustion gas pressure in the furnace would be higher than the potassium pressure in the boiler, but to guard against this contingency a wet scrubber would be included at the base of the stack so that it could be activated in an emergency. (auth)

5532 (ORNL-tr-2867) ELECTROLYTIC GRINDING MACHINE. 29 Mar 1972. Translation by Ernest G. Silver of French Patent 2,131,704. 6p. Dep. NTIS $4.00.

The invention concerns an electrolytic grinding machine of the classic type that consists of a disk-shaped grinder that constitutes an electrode made of graphite or of graphite containing embedded particles of abrasive grain materials such as diamond or metal carbides. The design drawings and schematics are given and its performance is described. (MCW)

5533 (RT/CHI-(74)9) VOLTAMMETRY ON STATIONARY ELECTRODES. Part II. Homogeneous Chemical Reaction Accompanying Charge Transfer to the Electrode. Casadio, S.; Magini, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jun 1974. 18p. (In Italian). Dep. NTIS (US Sales Only) $4.00.

A numerical solution is reported for the boundary value problem related to charge transfer coupled to a chemical homogeneous reaction at plane stationary electrode for potential scan voltammetry. (tr-auth)

5534 (SAND-74-0065) LAMINAR AIR FLOW FACILITIES SERVICE GUIDE FOR USERS, ADMINISTRATORS, AND CONTRACT SERVICEMEN. Stinnett, L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 26p. Dep. NTIS $4.50.

Procedures are given for implementing care and servicing of clean benches, clean rooms, contamination control systems, exhaust hoods, air filter systems, and other devices that use absolute or high efficiency particulate air (HEPA) filters. Past practices, corrective measures, and specific procedures are discussed. (auth)

5535 (SAND-74-0127) TECHNIQUE FOR MEASURING ABSORBED ENERGY PROFILES TO THE MELT LEVEL IN ELECTRON BEAM EXPERIMENTS. Elrick, R. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 28p. Dep. NTIS $4.50.

The calorimeter technique was developed to measure the profile of energy absorbed in a material exposed to an electron beam. The technique extends the range of absorbed energy that can be measured to at least the incipient melt energy of the material (or until the material spalls). The calorimeter, which is rugged and easy to calibrate, is a variation of the total stopping calorimeter developed and used by experimenters to measure total absorbed fluence in a material. A deposition profile in lead was measured in which the front surface temperature was about 560°C above the melt temperature of lead. This profile was subsequently used to compare some experimental results. (MCW)

5536 (SAND-74-0207) COHERENT PROCESSING. Hansche, B. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 14p. Dep. NTIS $4.00.

Coherent processing is based on the capability of a lens to do a two-dimensional Fourier transform on data consisting of a two-dimensional array of optical amplitudes. If a particular frequency component f_x in the picture is considered to be a grating, then this grating deflects a coherent plane wave an amount given, to the small angle approximation by $\alpha = \lambda f_x$ where λ is the optical wavelength. The lens then focusses this light at a position whose angle depends on the angular orientation of the grating, and whose radial distance can be seen to be $\xi = F \lambda f_x$. Since the grating will also diffract a component in the direction $-\alpha$, the display in the transform plane will exhibit radial symmetry. The processing consists of placing objects of varying complexity in the transform plane to operate on the transform of the picture and then inversely transforming the result with another lens. (MCW)

5537 (SAND-74-5528) COMPUTATIONAL METHODS FOR STRESS WAVE PROPAGATION IN NONLINEAR SOLID MECHANICS. Bertholf, L. D.; Herrmann, W. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 16p. (CONF-741001-12). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Numerical finite difference methods for the solution of stress wave problems in solid materials are discussed. Emphasis is placed on widely used Lagrangian and Eulerian methods for problems in two space dimensions. After a brief description of one particular representative computer program embodying each method, capabilities of the methods are illustrated by displaying a number of numerical solutions, and comparing them with exact and approximate analytical solutions, and with experimental results. (auth)

5538 (SC-RR-72-0126) ADAPTIVE, DIRECTIONAL TWO-PHONE SEISMIC DETECTION SYSTEM. Edrington, T. S. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1972. 8p. Dep. NTIS $4.00.

A preliminary design and brief field test of a two-phone seismic detection system are discussed. The two-phone scheme offers the advantages of controlled false-alarm rate, directivity, and increased sensitivity over existing one-phone systems. (auth)

5539 (UCRL-75731) ADAPTATION OF A THREE-DIMENSIONAL ATMOSPHERIC TRANSPORT-DIFFUSION MODEL TO RAINOUT ASSESSMENTS. Lange, R.; Knox, J. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Sep 1974. 48p. (CONF-741003-2). Dep. NTIS $5.50.

From precipitation scavenging conference; Champaign, Illinois, USA (13 Oct 1974).

A hybrid Lagrangian-Eulerian atmospheric transport-diffusion model has been developed and validated for calculating the three-dimensional distribution of atmospheric pollutants in transient region flow fields. This code, ADPIC, has been validated against several existing closed form analytical solutions including (1) a puff release in steady unidirectional shear flow and (2) a puff release with scale-dependent horizontal and vertical eddy diffusion coefficients. These verification tests indicate that the ADPIC calculational method reproduced the standard deviation of the pollutant distribution within 5%. Regional tracer releases of methyl iodine at Idaho Falls also have been used to validate the capability of the code to estimate the regional distribution of the pollutant. These results are compared to measurements obtained by NOAA. The ADPIC code for rainout assessments has been adapted to include radioactive decay and removal of debris from the cloud by wet deposition processes. The changes in the surface radiation field due to explicit inclusion of speed and direction wind shear and time-dependent wet deposition for FAB shots with a 1-kt yield are explored in a parameter variation study. (auth)

5540 (UCRL-76112) PROCESS-CONTROL COMPUTER SYSTEM DEVELOPMENT: A PHILOSOPHY. Fisher, D. K.; Holloway, F. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. 13p. (CONF-741001-15). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

A general philosophy is presented for the systematic design and development of process-control computer systems. This philosophy, which makes extensive use of large-scale computers and embodies the general concepts of design teams and iterative top-down design and implementation, increases the probability of success of such systems while minimizing overall development costs. Practical application of the approach is demonstrated by the development of a direct-digital process-control system for a multiple-actuator shaker. (auth)

5541 (Y-1960) STUDY OF WATER TURBINE PUMP FAILURE. Schmitt, C. R.; Lambert, F. J. Jr.; Hall, J. E.; Garden, G. C. (Oak Ridge Y-12 Plant, Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 21p. Dep. NTIS $4.00.

The cast iron discharge head of a 0.347-m^3/s (5500-gmp) deep-well vertical turbine pump experienced a rupture at the Melton Hill Lake raw-water intake pumping station of the Oak Ridge water system. Metallurgical studies of the failure showed the presence of some porosity defects in the cast iron, with tensile strengths ranging from 76.0 to 102.0 MPa (11,000 to 14,800 psi)—considerably below the 206.8 MPa (30,000 psi) specified. (auth)

COMPLETE OR PARTIAL COLLECTIONS OF USAEC REPORTS IN COUNTRIES OTHER THAN THE UNITED STATES

ARGENTINA
Buenos Aires, Comisión Nacional de Energía Atómica

AUSTRALIA
Canberra, National Library of Australia
Sutherland, New South Wales Atomic Energy Research Establishment

AUSTRIA
Vienna, International Atomic Energy Agency (IAEA)
Vienna, Zentralbibliothek der Physikalischen Institute der Universität

BELGIUM
Brussels, European Atomic Energy Community (Euratom)
Mol-Donk, Centre d'Etude de l'Energie Nucléaire

BRAZIL
Rio de Janeiro, Comissão Nacional de Energia Nuclear
São Paulo, Instituto de Energia Atómica

CANADA
Chalk River, Ontario, Atomic Energy of Canada, Ltd.
Hamilton, Ontario, McMaster University
Ottawa, National Research Council

CONGO, REPUBLIC OF
Kinshasa, Trico Nuclear Center

DENMARK
Risö, Danish Atomic Energy Commission

FINLAND
Otaniemi, Teknillinen Korkeakoulu

FRANCE
Saclay, Gif-sur-Yvette, Centre d'Etudes Nucléaires de Saclay

GERMANY, WEST
Karlsruhe, Zentralstelle für Atomkernenergie Dokumentation
Munich, Technische Universität

GREECE
Athens, Nuclear Research Center, Democritus Library

INDIA
Bombay, Trombay, Bhabha Atomic Research Center Library

IRAQ, REPUBLIC OF
Baghdad, Atomic Energy Commission, Nuclear Research Institute

IRELAND
Dublin, University College

ISRAEL
Yavne, Israel Atomic Energy Commission, Soreq Nuclear Research Centre

ITALY
Ispra, Cetis Library
Rome, Centro di Studi Nucleari della Casaccia

JAPAN
Tokyo, National Diet Library
Tokai-Mura, Naka-gun, Ibaraki-ken, Japan Atomic Energy Research Institute

KOREA, REPUBLIC OF
Seoul, Atomic Energy Research Institute

MEXICO
Mexico, D. F., Comisión Nacional de Energía Nuclear

NETHERLANDS, THE
Petten, Reactor Centrum Nederland
The Hague, Bibliothek Octrooiraad

NORWAY
Kjeller, Institutt for Atomenergi

PORTUGAL
Sacavem, Junta de Energia Nuclear

SOUTH AFRICA, REPUBLIC OF
Pretoria, Atomic Energy Board Library

SPAIN
Madrid, Junta de Energia Nuclear, Ciudad Universitaria

SWEDEN
Nyköping, Aktiebolaget Atomenergi Library

SWITZERLAND
Zürich, Swiss Federal Institute of Technology

UNITED KINGDOM
Boston Spa, Wetherby, Yorkshire, British Library Lending Division
Harwell, Didcot, Berkshire, Atomic Energy Research Establishment

IN INTERNATIONAL AGENCIES

EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM)
Brussels, Belgium
Ispra, Varese, Italy, Cetis Library

OECD NUCLEAR ENERGY AGENCY (NEA)
British Library Lending Division
Boston Spa, Wetherby, Yorkshire, England

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)
Vienna, Austria

UNITED STATES
ATOMIC ENERGY COMMISSION
P. O. BOX 62
OAK RIDGE, TENNESSEE 37830

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U. S. ATOMIC ENERGY COMMISSION

G

E AND FEES PAID
NMENT PRINTING OFFICE

U.S.MAIL

U.S.MAIL

XEROX UNIVERSITY MICROFILMS
SERIALS DEPT.
300 N. ZEEB ROAD
ANN ARBOR, MI 48106

1

Technical Books & Monographs

Sponsored by the
United States Atomic Energy Commission

1974 Catalog

This bibliography of publications sponsored by the U. S. Atomic Energy Commission over the past 26 years provides access to a large body of basic knowledge generated by the AEC research and development programs. The catalog gives for most publications a brief descriptive statement, lists or describes the contents, and indicates the availability.

Included in the more than 400 publications are titles from several AEC monograph series, prepared for the AEC by the American Chemical Society, American Industrial Hygiene Association, American Institute of Biological Sciences, American Nuclear Society, and American Society for Metals. In addition to the technical books and monographs, a section at the end of each subject category lists recent symposium proceedings published as AEC project reports. Title, author, and series indexes are provided. 134 pages, 5½ by 8½ inches.

Available as TID-4582-R10 without charge from

USAEC Technical Information Center
P. O. Box 62
Oak Ridge, Tennessee 37830

Subject Categories

- *General Reference*
- *Biology and Medicine*
- *Chemistry*

- *Computers*
- *Energy*
- *Engineering and Instrumentation*

- *Environment*
- *Health Physics*
- *Isotope Separation*

- *Metallurgy*
- *Physics*
- *Reactors*
- *Vacuum Technology*